



THE  
INDIAN JOURNAL OF SURGERY



Volume X

1948



# THE INDIAN JOURNAL OF SURGERY

Vol. X

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# THE INDIAN JOURNAL OF SURGERY

Vol. X

MARCH 1948

No. 1

## "TUMOURS OF THE SPINAL CORD"

by DR. N. S. NARASIMHAN, F.R.C.S., Surgeon, Govt. General Hospital, Madras.

To Gowers and Horsley must be assigned the credit for the birth of spinal cord surgery. In 1887 they correctly diagnosed and removed a primary spinal cord growth and also analysed the records of 58 cases of which only one had been submitted to surgery. Since that day spinal cord tumours are being daily more frequently recognised and removed, so that the mortality in cases treated surgically has decreased considerably. In the hands of Elsberg it has reached 2% in his last 100 cases.

Nevertheless one feels that several cases of spinal tumours remain undiagnosed or are only recognised when they have reached a late stage. It is often possible in a busy out-patient department to dismiss a case with, for example, root pain, as neuralgia and several cases of early spinal tumour have been mistaken for acute appendicitis (Kinier Wilson)? During examination of a large number of cases of backache, sciatic pain and brachial neuralgia seen in the Orthopaedic out-patients by the writer the possibility of a tumour of the cord has been kept in mind. Three cases of extensive neurofibroma of the trunk were investigated because they complained of indefinite radiating pain but a spinal block could be demonstrated only in one case.

The following seven cases of spinal cord tumour are being presented with a view to illustrate the difficult points in diagnosis. Two of these cases were at first misdiagnosed though the symptoms were not atypical. These cases were seen in the period between December 1943 and December, 1947.

## CASE REPORTS

### Case 1.

P., Gownder, male, 35 years, was admitted into the medical wards complaining of inability to walk for the past three months, pain in the back and incontinence of faeces. He was referred to the Surgical side as a case of tuberculous disease of the spine.

The patient gave a history that a year ago he had fallen from a height of ten feet but, except for a little tenderness over the small of the back which lasted for four days, he had no other symptoms. Six months ago he noticed severe stabbing pain in the back which increased at night, but which did not prevent him from doing his work. He then gradually noticed that his legs were becoming weaker so that he had an unsteady gait. With the onset of unsteadiness he also lost control of his bladder and rectum.

On examination it was found that he had complete paraplegia. Inspection of the spine revealed a marked posterior curvature in the dorso-lumbar region with a slight lateral curvature to the right. The dorso-lumbar region was tender. This tenderness was most marked over the 11th and 12th D.V. There was no spasm of the spinal muscles. Motor power of the upper extremities was normal, but was lost in the lower limbs which were equally wasted. Sensation was completely lost below the level of the middle of the thighs and there was a saddle-shaped area of anaesthesia. The tendon jerks were absent in both lower extremities and the cremaster reflex could not be elicited. Abdominal reflexes were present on the right side. The anal sphincter was lax and the patient had precipitancy of micturition. X-ray revealed no bony disease even on careful re-examination although at operation and subsequently at the autopsy the laminae and the posterior aspects of the bodies of the vertebrae were seen to be eroded.

Lumbar puncture showed that the C.S.F. was clear, was not under pressure and the Queckenstedt test was negative.

Cistern puncture revealed that the C.S.F. was normal.

Proteins — 30 mgms.

Globulin — nil.

Sugar — 57.5.

Chlorides — 740 mgms.

Wassermann Reaction — Negative.

2 c.c. of lipiodol injected into the cistern was completely held up at the level of the body of the 9th dorsal vertebra and had not leaked downwards after 24 hours.

Laminectomy was undertaken under intra-tracheal  $C_2E_3$  after premedication with 3 drms. of paraldehyde per rectum. The laminae of the 8th, 9th, 10th and 11th dorsal vertebrae were removed. The left lamina of the 9th dorsal was found eroded and the dura was bulging through the space. On opening the dura a gelatinous looking tumour about one inch in diameter involving the posterior surface of the cord for about 5 inches from the 8th segment was visible; below this obstruction, the cord was not pulsating. As the tumour was extensive and was thought to be intramedullary only a portion of it was removed.

The patient recovered from the initial shock but showed no general improvement. There was no relief of any symptoms. The operation wound healed by first intention but the patient deteriorated in health and died one month after operation of bed sores and cystitis. The Pathologists' report on the piece of tumour tissue was 'Neuro-fibroma.'

On partial post-mortem of the spine it was found that the laminae were eroded to a length of five inches. There was erosion of the posterior surfaces of the bodies of the corresponding dorsal vertebrae. The spinal canal was increased to more than three times its normal size. The cord and nerve roots could not be identified separately and the growth had extended through the intervertebral foramina which were increased in size. Histological examination of several sections of the autopsy material showed the same neuro-fibromatous structure. The spinal cord could not be taken out for preservation.

## Case 2.

Ramaswami, aged 25 years, a weaver by occupation was admitted on 12-11-45 for inability to use the lower limbs and neuralgic pain in the chest for the last 8 months. On questioning he gave no history of injury. He stated that all of a sudden, he had noticed severe pricking pain on the right side of the chest at the level of the nipple. The pain was initially confined to the right 5th intercostal space but gradually spread round the chest during a period of two months. This constant pain disturbed the patient's sleep and occupation. He then noticed numbness gradually spreading over both lower limbs from toes to groins, and there

was occasional tingling. Within a fortnight he had difficulty in walking and within a month was unable to leave his bed. During a further period of a month he noticed that he was unable to bend his knees, but experienced occasional painful flexor spasms. For this pain and spasm he consulted a doctor and was given anti-syphilitic treatment (four injections) without relief. At the same time the patient lost bladder and rectal control and sought admission to hospital.

He was admitted into the venereal wards and it was found on examination that he had spastic paraplegia and loss of all sensation from 2 inches below the nipple downwards with a band of hyperaesthesia above this level. Both anal and bladder sphincters were incompetent, so that the patient had incontinence of urine and faeces. The laxity of the anal sphincter was evident on digital rectal examination.

On lumbar puncture the C.S.F. was not under pressure and, though Xanthochromic, did not clot. Bio-chemical examination revealed protein excess — 600 mgms. Globulin — and 13 cells (lymphocytes) per c.m.m. Both the blood and C.S.F. gave a negative Kahn reaction but the Wassermann was positive. An X-ray of the spine showed no evidence of bony disease. On the strength of the positive W.R. and the cells in the C.S.F. a diagnosis of spinal syphilis was made by the Venereologist and the patient given 20 injections of 20 c.c. of sod. iodide intravenously on alternate days from 24-11-45 and 7 intramuscular injections of 0.2 gm. of bismuth weekly. There was no relief of symptoms and a spinal tumour was suspected on account of failure of treatment and the marked radicular neuralgia.

To locate the site of the tumour, cistern puncture was done and 3 c.c. of lipiodol was put in; X-ray revealed the lipiodol to be held up at the 4th thoracic vertebral body in a cup-shaped form. The C.S.F. from the cistern was clear and contained 50 mgms. per cent proteins, globulin nil, chlorides 630 mgms. and a few R.B.Cs. Hence a diagnosis of intradural tumour at the level of the 4th thoracic vertebra was made. (In a patient with a spinal tumour and a positive Wassermann reaction comparison of protein values of cistern and lumbar puncture is of value.)

Under rectal ether in oil and local Novocaine (½% solution) infiltration, the laminae of the 2nd to 6th dorsal vertebrae were removed. The lipiodol put in was seen at the level of the 4th dorsal vertebra and the dura was pulsatile above the 2nd dorsal vertebra. On opening the dura a soft tumour, about one inch in vertical extent, was seen covering the anterior and posterior surfaces of the cord, adherent in places to the dura. The adhesions were easily separated and the tumour removed with little bleeding. The tumour appeared

extramedullary. Pathological examination of the tumour proved it to be a fibroblastoma. (Fig. 1.)



Fig. 1.

Fibroblastoma:—Low power photomicrograph showing the fibroblasts in irregular columns and cells with abundant cytoplasm and dark round or oval nuclei.

Ten days after operation the patient felt heaviness of both lower limbs, but the neuralgic pain round the chest had completely disappeared. For about a month he had not regained control of his bladder or rectum but could feel when the bladder was full. Flexor spasms had disappeared. Two months after operation he could flex and extend his knees. Touch, pin-prick and vibration sense were normal in both the lower limbs. Sense of position and passive movement was not accurate. Temperature sense:—Cold was not appreciated over the right leg and heat was inaccurately appreciated. Knee jerks were still exaggerated and the plantar response was extensor on both sides. Sphincter control was normal. He was able to get about with crutches.

### Case 3.

Venkatapathy, aged 29 years, came to hospital complaining of severe pain over the left hip and thigh confined more to the lateral aspect of the limb. This pain had started abruptly two years ago and had increased in intensity since then preventing him from pursuing his usual occupation. The pain was continuous, shooting and piercing in character, often made worse by bending, coughing or by movement of the spine. It was not paroxysmal, nor lightning in type. It was so constant that his sleep was disturbed and this made him seek medical advice. No history of injury could be elicited nor was there history or evidence of venereal disease.

The patient appeared fairly well nourished, his weight being 102 lbs. He had a mild kyphoscoliosis with a tilt towards the right and the glutei and hamstring muscles on the left appeared wasted. On examination there was slight tenderness over the lumbar spine and a mild degree of

spasm of the spinal muscles in that area. The movements of the spine were normal except lateral flexion which was painful. Both hip joints appeared healthy. To exclude early tuberculosis of spine or hip both areas were X-rayed, but no abnormality was found. The blood sedimentation rate was normal. The patient had a normal temperature and blood Wassermann and Kahn were negative. In spite of negative X-rays the left hip and lumbar spine were immobilised in a plaster spica as a therapeutic test. A fortnight's immobilisation only served to intensify the pain according to the statement of the patient who continually demanded morphia as no other analgesic relieved him. It now appeared likely that one was dealing with a tumour of the spinal cord, and a complete neurological examination was undertaken. There was wasting of the right gluteal muscles: sensation and reflexes normal.

A lumbar puncture was done. The CSF. was not under pressure, was tinged yellow, but there was no spontaneous coagulation. Biochemical examination revealed protein 100 mgm. Globulin + + chlorides 600 mgms. sugar 60 mgm. There were no cells. Lange's test was normal, and W R and Kahn were negative. These findings were suggestive of a sub-arachnoid block. With a neuralgic pain in the gluteal region and thigh, wasting of the gluteal muscles, the existence of a

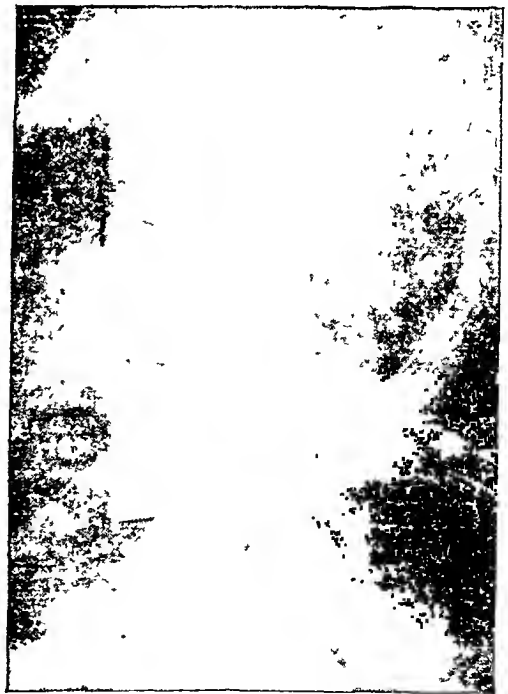


Fig. 2.

tumour of the spinal cord was considered a possibility.

A cistern puncture was done and 2 c.c. of lipiodol instilled into the sub-arachnoid space. An X-ray revealed a block at the level of the 3rd lumbar body the lower level of the lipiodol being concave upwards. After 24 hours, the lipiodol was seen in streaky lines, suggesting a partial block (Fig. 2). The fluid from the cistern was normal (proteins 20 mgms., globulin nil, sugar 90 mgm.) The patient complained of more severe pain after the lipiodol injection. A laminectomy was carried out under rectal ether and local nerve block. The laminae of L<sub>3</sub>, 3 and 4 were removed, when the dura was found pulsating down to the cauda equina. On opening the dura C.S.F. mixed with lipiodol escaped. On the anterior surface of the cauda equina and spreading on both sides of it but more on the right was a thinly encapsulated gelatinous tumour about one inch in diameter. The tumour was free from the nerve roots and appeared to arise from the arachnoid. It was shelled out completely and the dura sutured. The tumour sent for pathological examination was found to be a neuro-fibroma. (Fig. 3.)



Fig. 3.

**Neurofibroma:**—Photomicrograph showing the reticulated appearance of the tumour with delicate capillaries. Top left—Pallisade formation of the tumour cells.

The patient had a continuous intravenous drip of 5% glucose saline during and after operation. He stood the operation well. For the first five days he could not pass urine and was catheterised every eight hours. On the 6th day he passed urine and catheterisation was no longer required. The bowels were very constipated and needed attention. The neuralgic pain did not disappear for the first week after operation. From the 10th day it gradually disappeared and was replaced by a feeling of numbness in the thigh and leg. The patient complained of intense headache for the first three days after operation. This was relieved by keeping the head lowered and by intravenous injections twice a day of 50 c.c. of 50% glucose.

One month after operation, examination revealed the following points:—Motor power of both lower limbs was good. There was loss of touch, pain and temperature—sense over the sole of the left foot, and paraesthesia (tingling and numbness) over the distribution of the left peroneal nerve. All reflexes were normal. The patient was able to go about normally and had complete control of bladder and defaecation. On digital rectal examination it was noticed that the anal sphincter was not as tight as in Case 2. The patient was re-examined two months and six months after discharge and was progressing well. For the past two years, he is working on the fields.

#### Case 4.

R. V. Raju, aged 33 years, Merchant, was admitted in the Venereal department of the hospital on 7-7-46 with the following complaints:

1. Pain in the left hip region followed by pain in the right hip shooting downwards—Duration 1½ years.
2. Difficulty in walking since 8 months.
3. Difficulty in voiding urine since 8 months.
4. Poor libido.

**Previous history:** Married 2 years ago, no children, he had smallpox in the 15th year, pain in the right half of scrotum and perineum in his 16th year and had suffered from mumps in the 17th year. No history of penile sore but had injections for discharge.

**Clinical examination** revealed the following findings:

Patient was fairly well-nourished. He was slightly anaemic, and had clubbing of the fingers and toes. He had no active evidence of V.D. There was no deformity of the spine or tenderness over it.

**Cardio-vascular system:** Nil abnormal.

**Respiratory system:** Nil abnormal.

**Central Nervous system:** All the cranial nerves were normal. Pain and sensation in the upper limbs were normal. There was bilateral foot drop. The lower limbs were spastic and power was diminished. There was wasting of the calf muscles relatively more on the left side.

**Reflexes:** Superficial—abdominal reflexes were present in all quadrants. Cremasteric reflex was absent on both sides. Plantar reflex was flexor on the right side and extensor on the left side. Deep-Biceps, triceps and brachio-radialis reflexes were normal. Knee and ankle jerks were normal on the right side and exaggerated on the left.

Patient had to apply pressure over the suprapubic region to empty the bladder. Anal sphincter went into spasm on rectal examination. Temperature, pain and tactile sensations were lost over

a saddle shaped area covering both gluteal regions and the perineum and blunting of all sensations over the skin of the external genitals. Testicular sensation was normal. There was loss of all sensations below the tendo-achilis on both sides. Vibration sense was lost on the left side but present on the right.

**Gait:** Patient walked with support with a high stepping gait. Rombergism was present. Heel knee test and Finger nose test were normal.

Trophic ulcers were present over the upper part of natal cleft and the posterior aspect of the left heel.

**Laboratory findings:** Blood fbr Kahn—Negative. Spinal fluid—Queckenstedt's sign—Negative. Fluid was yellowish and not under pressure. Cells—3 per cmm.—all lymphocytes. Total protein—1500 mgms.%. Globulin +++ W.R. 0.1 c.c. and 0.5 c.c.—doubtful. Lange's test—Negative.

Cistern puncture was done in the erect posture  $\frac{1}{2}$  c.c. of lipiodol was put in. Skiagram of the spine after lipiodol was suggestive of adhesions and presented guttering in the region of the 8th, 9th, 10th and 11th dorsal vertebrae. No bony changes were noted in the spine.

Urine — Nil abnormal.

Blood picture — Nil abnormal.

Fractional test meal — Nil special.

**Electrical reactions of muscles:** The following changes were noted in the muscles of the lower limbs.

	Right.	Left.
Thigh ant. aspect.	Normal.	Normal.
" post aspect.	"	"
Leg post. aspect.	Weak normal.	Weak normal.
" ant. aspect.	P.R.D.	P.R.D.
Foot.	"	"

**Ophthalmoscopic examination:** Nil particular.

In view of the fact that the spinal fluid revealed Xanthochromia and increase of proteins compression of the cord was thought of. Lipiodol pictures of the vertebral column revealed the presence of 'guttering' which was highly suggestive of arachnoiditis. The anatomical site of the lesion was localised at the lumbo-sacral region because of the following reasons:

- 1 There was absence of cremasteric reflex.
2. Lipiodol guttering spots were present at the anatomical level of the 9th dorsal vertebra. (Fig. 4). Further the shadow of lipiodol was a straight line on the right side and irregular on the left and hence this pointed to the lesion being more on the left side.
- 3 The lower level of the adhesions had not been determined by lipiodol but clinically it seemed as though it involved the sacral segments

too, in view of the saddle shaped anaesthesia and anaesthesia over the tendo-achilis

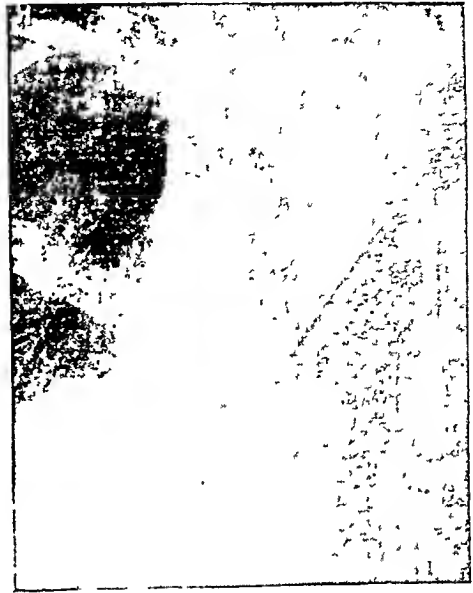


Fig. 4.

Lipiodol picture of Case 4.

The diagnosis of arachnoiditis was made and 5 million units of penicillin were given. It was found that a few signs and symptoms improved. Touch, temperature and pain sensibility were nearly normal as far as the knee on both sides. Saddle-shaped anaesthesia also improved. The left knee and ankle jerks exaggerated. Bilateral cremasteric reflex was absent. Since the essential features of compression persisted and cell count was only 3 (lymphocytes), it was strongly suggestive of a cord tumour and the patient was transferred from the venereal department. Again lumbar and cistern punctures were made. Lumbar puncture fluid was not under pressure. Xanthochromia was present. The specimen clotted in a few minutes. No cells were found. Proteins were 5 gms. of which globulin was 2 gms. Though the pressure of the fluid was not increased by pressing the jugulars, it flowed in jerks when he coughed, indicating that the block was not complete. Cistern puncture specimen was clear. Protein was 100 mgms.% and globulin was just present. It contained a few R.B.C. and WBC. With the above findings an exploration was decided upon.

After premedication with paraldehyde under gas and oxygen supplemented with local ( $\frac{1}{2}$ %) novocaine 80 cc an incision about 6 inches long was made on the middle of the back with the 10th dorsal spine as the midpoint. Posterior spinal

muscles were retraced. Four trephine holes were made and the laminae were removed. It was found that the cord did not pulsate from 8th d.v. downwards. Near the 10th dorsal vertebra a bony mass was found protruding towards the spinal cord. This was clipped off and just beneath it, a fleshy vascular tumour was found in connection with the spinal cord and duramater. On lifting up the mass there was profuse haemorrhage. The tumour was the size of a cherry, situated on the lateral aspect at the level of the 10th dorsal vertebra encroaching on the anterior aspect of the cord; the posterior surface of the body was eroded. On inspecting the eroded portion of the vertebra, a cavity  $\frac{1}{2}'' \times \frac{1}{2}'' \times \frac{1}{2}''$  was left after removing a mass of soft white tissue continuous with the tumour mass. It was found that the cord was constricted and narrowed above the site of the tumour and at the site it was flatter and broader. As much of the tumour as could be removed was excised in bits and sent for pathological examination. Bleeding was controlled by muscle graft. Duramater in the region of the 9th d.v. was slit and lipoidal was let out and washed with 20 c.c. of normal saline. Even at the end of the operation the cord did not pulsate but no further cause for obstruction was noted. Operation was completed, with muscle and skin stitches. Plasma was administered during the latter part of the operation. Patient was nursed on his face.

*Path. report* was Neurofibroblastoma (Fig. 4a). He had flexor spasms on the left side and developed retention of urine. He had to be catheterised and was put on sulphathiazole tablets and penicillin 15,000 units every 3 hours. 2 days later he began to have control over the bladder.

Sutures were removed. The wound healed by first intention. Patient was put on his back. Gradually he was encouraged to sit and hand down his legs. The pain in the limbs improved day to day. His sensations of touch, pain and temperature were better appreciated all over both the limbs though still impaired. His knee jerks were normal. There was no ankle clonus or extensor planter response on the left side. He was given boots with lateral iron and was walking with crutches.

#### Case 5.

Mr. Venkatasubramaniam, Male, aged 42 years, was admitted for inability to use the lower limbs which were rigid in a flexed position with flexor spasms.

*History of illness* In 1934 he had an attack of fever with dysentery for which he got treated. Following this he began to feel a burning sensation over the lateral aspect of the muscles of the right thigh with occasional twitchings of the muscles of the thigh. The burning sensation then spread to the right leg and twitching appeared in the leg also. Along with this he noticed dryness of the skin of the lower limbs with wasting of the mus-

cles. Slowly the same symptoms appeared in the left leg also. All the time he was able to perform his work. For 4 years he was taking various medicines. Then in 1938 he came to this hospital on the medical side and the following investigations were done. Lumbar puncture:—Cerebrospinal fluid was positive for Wassermann. Chlorides 745 mgm.



Fig. 4a.

Meningioma:—Polyhedral or spindle-shaped cells arranged concentrically about a central lumen; the endothelial characters of the cells are well seen.

%, protein 80 mgm. % globulin trace, no cells. The gold curve was Meningitic. Fluid was not under pressure. No colour changes. Blood Wassermann—negative. He was given N.A.B. and was asked to report but he had no relief. In 1939 he was treated for Ichthyosis by a different physician. In 1940, as the symptoms persisted as before and spasms increased in frequency and the gait was unsteady, he came to the hospital again and a diagnosis of disseminated sclerosis by another physician was made. In 1941 in another hospital, lumbar puncture was done. Proteins 120 mgm. % Globulin 58.2 mgm. %, Chlorides 690 mgm. %, Wassermann negative, cells 2 per cmm. He was treated with Nicotinic acid and vitamins. He had no relief, the muscle spasms extended up the abdominal walls, to the epigastrium. In 1943 he had to give up attending his office. He was not able to walk about in the house, weakness of the lower extremities increased and he had to stay in bed.

Then his lower limbs got flexed and he again got himself admitted on 27-10-46.

**Examination:** Cranial nerves were normal except for nystagmus. He had spastic paraplegia with limbs in flexion and abduction and constant flexor spasms. All the reflexes of the lower extremities were exaggerated with ankle clonus and extensor plantar response. There was loss of sensation of touch, pain and temperature on the lateral aspect of right thigh, leg and foot. Abdominal reflexes were lost. Epigastric reflex present. No sensory loss. Abdominal muscles were rigid. During sleep he had no control over micturition but at other times he had precipitancy. He was constipated but was able to control defaecation. The rest of the nervous system and other systems were normal. A diagnosis of cord tumour was made and a lumbar puncture done. Fluid was clear, not under pressure, very little in quantity, Queckenstedt's phenomenon was absent. A few cells were present.

A cistern puncture was done. C.S.F. was clear and not under pressure 2 c.c. of lipiodol was put in and the Radiographs revealed a block at the level of the middle of the 4th dorsal vertebra with

localised to the 8th spinal segment from the rigidity of the muscles and the presence of the epigastric reflex. Lipiodol however showed arrest at the level of the 4th dorsal vertebra. (Fig. 5). It was decided to operate.

Under intratracheal gas and oxygen with local novocaine, laminectomy was done and the 2nd and the 7th dorsal laminae were removed. At the level of 5, 6, and 7th d.v. the dura was not pulsating. There was no extradural tumour. The dura was opened and lipiodol let out. A tumour 3" in length was found on the anterior aspect of the cord and extending into it. There was no capsule. The tumour was removed piecemeal. Pathological report was Glioma. (Fig. 6.)

During the post-operative period patient required catheterisation for a week. There was loss of sensation below the chest for three days. The number of flexor spasms were diminished. He passed urine by himself and had control over the



Fig. 5.

a smooth convex upper border. (Fig. 5)—Re-X-ray in 24 hours showed the same pattern with a little leak on the left side. As lipiodol was put in he complained of severe pain on the right side (arm). Clinically the upper level of the lesion could be

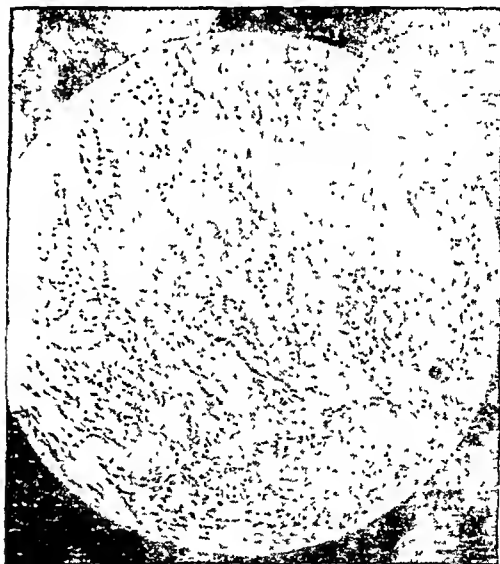


Fig. 6.

**Glioma (Fibrillary astrocytoma):**—Photomicrograph showing cells with scanty cytoplasm and deep staining nuclei; the fibrils in wavy parallels form an open network.

urinary sphincter but the anal sphincter was lax. Subsequently he developed bedsores over the sacrum and trochanteric regions; cystitis became severe; the paraplegia became flacid with oedema of legs. Temporary improvement resulted with sulphathiazole and Penicillin injections and blood transfusion. Nursing became very difficult. Gradually he lost ground and died. An autopsy was not available.



## Case 6.

Natesa Pillai, aged 50 years, was admitted on 10th December 1946 for pain in the chest since 5 months.

*History of the previous illness:* An excision of a neurofibroma which was situated on the right side of the back over the erector spinae was done in July 1946. That tumour was 3" by 3" and was of 8 months' duration.

*History of present illness:* A month after the excision of the neurofibroma he developed pain and burning sensation over the right side of the chest between the 3rd and 8th intercostal segments. The pain was almost constantly present.

On examination of the Nervous system all the cranial nerves were normal. There was slight impairment of the power of the muscles of the upper extremity but the other limbs were normal. Gait was normal and no Rombergism present.

*Reflexes—Superficial:* Abdominal reflexes were present in all quadrants. Cremasteric reflex was sluggish on both sides. Plantar reflex was extensor on the right side and normal on the left side.

*Deep:* Knee jerks were brisk on both sides and ankle jerk was weak on the left side. Jerks in lower extremities were normal.

*Sensation:* Touch was lost between the 6th and 8th segments on the right side and there was hyperaesthesia at the 6th segment.

Sphincters were normal.

*Alimentary system:* Nil abnormal.

*Respiratory system:* Harsh breath sounds over right apex. Feeble sounds over the left apex. Trachea was deviated to the right side.

*Cardio Vascular system:* Arteriosclerotic changes in the vessels were noted.

*Lumbar puncture:* C.S.F. was not under pressure and it was clear. Queckenstedt's phenomenon absent.

Proteins — 240 mgms. per 100 c.c.

Globulin — + +

Chlorides — 700 mgms. per 100 c.c.

Sugar — 63.2 mgms. per 100 c.c.

Wassermann — Negative.

Fundus showed arterio sclerotic changes; Disc was normal.

B.P. 160/105. Hb. 80%.

Urine — Nil abnormal.

A cistern puncture was done. Fluid was under normal pressure, slightly turbid and the Queckenstedt phenomenon was present. 2 c.c. of lipiodol was put in. The X-ray showed that there

was arrest at the level of the 5th thoracic vertebra.

Under intratracheal ether, gas and oxygen supplemented by local novocaine, incision was made from 2nd to 8th dorsal spines and laminae were removed by trephining and the space was widened by nibbling. Anterolaterally on the right side opposite to the 5th, 6th, 7th vertebral bodies, there was an extradural neurofibroma which had invaded the bone and vertebral foraminae. The tumour was traced through the vertebral foraminae into the chest and as much as possible was removed piecemeal. The 5th posterior root was also removed on the left side. Towards the end of the operation the right pleura got opened. There was an immediate fall in B.P. and the pulse became imperceptible; with the usual measures his condition improved and the operation was completed. 400 c.c. of whole blood was given from the beginning of operation, followed by glucose saline.

Patient died one hour after operation. Only a partial autopsy was available. Both the lungs were found collapsed. There was six oz. of blood-stained fluid in each pleural cavity; heart, lungs and bronchi were normal. There was a neurofibroma of the 5th, 6th and 7th intercostal nerves on the right side and the sympathetic chain was thick and fibromatous. 5th nerve on the left side was also affected. The dissected specimen and ribs are preserved in the Madras Medical College pathology museum (Figs. 7 & 8).

*Pathological report:* "Neurofibroma".

## Case 7.

F. A weaver, aged 35, was admitted on 30-9-'47 for inability to walk. When he came to the outpatient department he was seen to have severe extensor spasm of the muscles of the lower extremities.

*Previous history:* He gave a history of exposure to venereal disease 15 years ago. He said he had a white urethral discharge at that time, but was not quite definite about a sore on the penis.

*Family history:* Married, had five children, one died at the age of three years. No history of miscarriage by the wife; wife and the remaining children healthy.

*Present history:* The present complaint started two years back with gradual weakness and unsteadiness of one lower extremity. Ten days later he developed weakness and spasticity in the other and he was completely paralysed and unable to walk in a few months. Last year he went to Coimbatore Hospital for treatment where he was given 4 injections of N.A.B., five injections of bismuth and one or two injections of T.A.B. Vaccine.

*General Condition:* Patient was a fairly well-nourished individual of 35 years, not anaemic;

both his lower extremities were paralysed and went into severe extensor and flexor spasms periodically. Bowels constipated. There was difficulty in micturition, which the patient used to overcome by periodical expression.

*Nervous system:* Speech, intelligence and memory good.

*Cranial nerves:* All normal.

Patient had a spastic paraplegia, with exaggeration of the deep reflexes. Ankle clonus present. Bilateral extensor plantar present. Oppenheim and Gordon reflexes could be elicited. Mass reflex phenomenon could be easily elicited on slight pressure over any part of the lower limb,



Fig. 7.

Specimen of Rib and Neurofibroma of the intercostal nerve.

i.e., dorsi-flexion of the ankle, flexion of the knee and thigh. Sometimes he went into severe flexor spasm on slight change of posture of limbs. Abdominal and cremastic reflexes lost. Jerks in the upper extremity equal and normal.

*Sensation:* Light touch, temperature and pain lost completely below the level of the nipple. He also had a girdle sensation round about the nipple. This located the level of the lesion between 5th and 4th dorsal segments. Joint sense lost.

*Visceral reflexes:* There was no incontinence or retention of urine. He had difficulty in micturition. There was no incontinence of faeces.

*Investigations:* L.P. was done and yellow coloured fluid was drawn. Queckenstedt phenomenon absent. CSF. results:

Colour — Xanthochromia.

Proteins — 360 mgms.

Globulin — + +

Blood Kahn — 0.1 and 0.5 c.c. negative.

Wassermann — Positive.

Urine — Nil abnormal.

X-ray spine — No bony lesion.

Injection of iodised oil into the subarachnoid space: Hold up of iodised oil at the level of T.I.

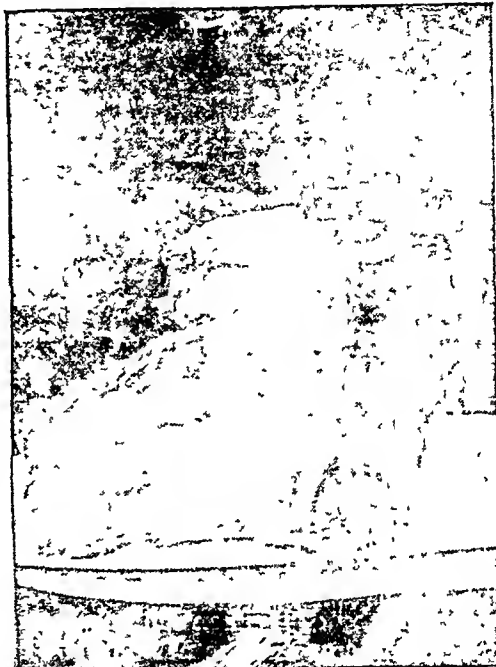


Fig. 8.

Spinal Cord with Neurofibroma.

The iodised oil remained in the same position even after 24 hours. A radiograph taken a fortnight after injection of iodised oil showed it was still held up at the same level and showed the characteristic cupping deformity.

Under general anaesthesia (endo tracheal gas oxygen ether) with local infiltration with novocaine, a laminectomy was performed, the centre of the incision being the spine of 7th cervical vertebra. The spinous processes and laminae of 5, 6, 7, 8 C. and 1 and 2 D. were removed. A non-pulsatile plum coloured mass protruding through a dural defect towards the left was seen; the cord was pulsating above the mass; the protruding mass which was granulomatous in appearance, friable and continuous with the cord was removed; the anterior aspect of the cord was free. Patient had 320,000 units of Penicillin in three days after operation.

Retention of urine had to be managed in the post-operative period.

The histological report was "Fibroblastoma"; the tumour was highly vascular.

A week after operation the patient complained of pain below both knees, worse on the left leg; ankle and knee jerks normal; Babinski, more brisk on the right side. Tone of flexor muscles greater than extensor; flexor spasm more on the right side; sensation of touch and position impaired to the level of the nipples. An area of hyperaesthesia present on the left side from the level of the left nipple upto the level of the sternal angle, strictly unilateral. Three days later hyperaesthesia was present in the anterior axillary fold on left side and slight hyperaesthesia along ulnar border of left arm. Hyperaesthesia over area of T1 & T2 same as before. Cremasteric and abdominal reflexes absent on both sides. Babinski and pain in left leg present as before.

The flexor spasm became greater five days later in both lower extremities than on previous occasions; more in left leg. Knee jerk exaggerated on left side, brisk on right side. Pain and hyperaesthesia were the same. Patient was able to go about in a wheel chair.

A month after the operation the patient lying with legs semiflexed, unable to extend; burning sensation in both legs, light touch and pinprick appreciated above the epigastrium on both sides; Babinski, knee jerks and ankle clonus were positive.

To this series of true cord tumours, a case of hypertrophy of ligamentum subflava producing symptoms and the notes of two cases of compression syndrome where a laminectomy did not reveal a cord tumour are also added below:

#### Case 8.

Male, aged 24 years, resident of Cuddapah dist., admitted on 22-6-1946.

His complaint was shooting pain on the right side along the course of the sciatic nerve and burning sensation over the right thigh since last three months. Pain increased on walking or standing for a long time. Since one month he noticed burning pain also on the left thigh.

On examination, he was a well nourished individual. The positive findings were exaggeration of the left knee jerk and pain on stretching the right sciatic nerve. He had tenderness over the spines of the 4th and 5th lumbar vertebrae.

Rectal examination — Nil abnormal.

Urine — Nil abnormal.

Blood — W.R. and Kahn — Negative.

X-ray lumbar spine — Nil abnormal.

On 25th June L.P. was done. Initial pressure was low. 20 mm. Quickenstedt's phenomenon present.

C.S.F. Total Protein — 30 mgms. per 100 c.c.

Globulin — Nil.

Chlorides — 720 mgms. per 100 c.c.

Sugar — 43.29 mgms./100 c.c.

Cell count — 1 lymphocyte.

W.R. — .1 c.c. .5 c.c. negative.

On 30th June 20 c.c. of novocaine was infiltrated into the right sacro-iliac region for relief of pain. Patient was not appreciably benefitted.

On 4th July cistern puncture was done. Fluid was not under pressure and was clear. Total protein was 40 mgms/100 c.c. and no globulin was present. Lipiodol was injected and was found to descend to the level of the 1st sacral vertebra without obstruction. A clinical diagnosis of hypertrophied ligamentum flava was made and on 9th July under spinal anaesthesia a linear incision was made and the spinous processes and laminae of L1, 2, 3 and 4 removed. The dura was cut and the spinal cord was inspected. No evidence of any tumour or abnormality of any nerve was noticeable. Wound was closed in layers.

The patient was discharged with complete relief of all the symptoms. This patient has been seen several times and is free from pain.

The absence of a pathological lesion in the cord and the relief following laminectomy suggest the ligament as the probable cause of the compression. This could have been demonstrated with proper technique of lipiodol myelography but was not done.

#### Case 9.

V., Patient, aged 23 years, resident of Madras, admitted on 28-1-47 for difficulty in walking and loss of control over micturition since last ten months.

He gave a history of a fall from 25 feet height, a year ago. He was not unconscious. After three months he noticed sudden retention of urine. Gradually he developed imperfect control of urinary sphincter. He had also developed burning sensation as well as pins and needles over lower half of abdomen and lower extremities. Further he had occasional tremors of hands and irregularity in the bowels.

On examination of the nervous system the cranial nerves were normal. Motor power was impaired in all the four limbs. Co-ordination was normal.

**Jerks:** Knee and ankle jerks on both sides were exaggerated. Upper limb jerks were normal. Ankle and knee clonus were present. There was bilateral extensor plantar response. Cremasteric

reflex was absent on both sides. Abdominal reflex was absent in lower quadrants.

*Sensation*: Light touch was impaired below both ankles. Heat and cold was not appreciated over the whole of the left leg. Pin-prick was absent below the left knee. Vibration sense was lost up to the iliac crest on the left side. Joint sense was normal.

No zone of hyperaesthesia was present. Clinically the lesion was suspected to be at the 10th dorsal segment of the spinal cord.

Urine — Nil abnormal.

B.P. 90/65 Hb. 60%

X-ray spine: Lumbar and sacral region — Nil abnormal.

On 30th January Lumbar puncture done. Fluid clear, not under pressure. Queckenstedt's test showed an initial quick rise to 35 cm. and a gradual fall to normal (15 cm.) within just over 2 minutes.

#### Bio-chemical tests:

Proteins — 20 mgms.

Chlorides — 720 mgms.

Sugar — 57.8 mgms.

Globulin present.

Cell count — 30 cells.

Blood — Wassermann and Kahn — Strong positive.

The Venereologist advised antisyphilitic treatment, with sodium iodide and bismuth.

A second lumbar puncture done. The fluid slightly under pressure.

Total proteins — 60 mgms.

Chlorides — 680 mgms.

Sugar — 60 mgms.

Globulin present.

Total cell count — 40 cells per c.mm.

Gold curve — 0.1 c.c. precipitated.

0.5 c.c. precipitated.

55111,00000.

The antisyphilitic treatment was completed but the patient did not improve. The fractional test-mant and B.M.R. estimation were normal.

A cistern puncture was done and 2 c.c. of lipiodol put in. A myelogram was taken.

Cistern puncture C.S.F. showed Proteins — 10 mgms. %. Globulin — Nil. Cells — Nil.

The Myelogram showed that the lipiodol was held up at 6th and 7th dorsal level. Therefore a diagnosis of spinal cord tumour at the level of the 7th dorsal segment was made.

Under intra-tracheal anaesthesia supplemented by 100 c.c. of 1% Novocaine, a longitudinal mid-

line incision from the 5th dorsal vertebra to 10th dorsal was made. Laminectomy of 6th, 7th, 8th and 9th thoracic vertebrae was done. During the operation a considerable amount of bleeding from the bones on the left side was noted. The spinal cord was found to be pulsating well. No bulging, oedema or thickening of the cord or dura was noticeable. The dura was opened and C.S.F. flow was free. The lipiodol was removed. There was no evidence of arachnoiditis. The anterior aspect of the spinal cord was inspected. No abnormality was noticed. Anterior surface of the dura also showed no abnormality. Wound was closed in layers.

In the post-operative period, patient developed retention of urine and was being catheterized 6th hourly followed subsequently by incontinence. Bed-sores over right great trochanter and right knee and ankle developed. He was unable to lift up both the lower extremities and developed parallegia in extension. Patient was given one megaunit of Penicillin.

The patient later was able to sit up but not walk without support. Bed sores gradually healed. He had loss of sensation to touch and pin-prick over left lower extremity right up to the iliac rest. Bilateral extensor plantar response persisted. Urinary and rectal sphincter control was normal.

The patient has subsequently improved in general health but his cord symptoms have remained the same. This is probably a case of a vascular disorder of the spinal cord in a Syphilitic patient. He had received three megaunits of Penicillin which was given as the radiograph showed lipiodol in streaks in the lumbar region. Lumbar puncture and manometry shows normal pressure of C.S.F. with correct response on jugular vein pressure and C.S.F. normal with no protein and with negative reactions of Khan and W.R.

#### Case 10.

K., aged 25 years, was admitted in the surgical wards on 6-5-47.

*History of the previous illness*: The patient gave a history of a sore on the penis six months ago. He had a fall 10 months ago. For the first 4 days after the fall he was unable to pass urine or motion. He was treated in Trichy for retention of urine and a suprapubic catheter was inserted. The patient then developed incontinence of urine and faeces. 15 days after the accident he suddenly developed paralysis of both the lower extremities with severe flexor spasms for which he was treated in the medical wards for three months. He had a course of curare injection of 5 c.c. I.V. on alternate days for 3 days and later 2 c.c. His complaint on admission was pain and tenderness over the lumbar spine and incontinence of urine and motion.

On examination, he was a well nourished individual.

*Nervous system:* All the cranial nerves were normal. Pain and light touch sensations were diminished in the right side in the region of L.4 and L.5 and on the left side at the level of S.2. Joint sense and sense of position were absent on both sides. There was a zone of hyperaesthesia at level of D.8 segment.

*Reflexes—Superficial:* Abdominal reflexes were normal. Cremasteric reflex was absent on both sides. Plantar reflex was extensor on both sides. Deep-Knee/jerk was exaggerated on both sides. Jerks were normal. Visceral: Incontinence of faeces and urine were present. (Patient appreciated when micturition started but he was not able to control the flow).

Lumbar puncture was done thrice and showed a gradual increase in proteins. Fluid was clear and not under pressure. Quackenstedt's phenomenon was present.

February:

Total proteins — 40 mgms. %

Globulin — +

No cells.

March:

Total proteins — 60 mgms. %

Globulin — +

No cells.

Lange's colloidal Gold  
reaction was 003330000

April:

Total proteins — 80 mgms. %

Globulin — +

No cells.

C.S.F. W.R. — Anticomplementary.

Cistern puncture. Total proteins — 30 mgms. %

Globulin — Nil.

Blcod W.R. Kahn — Negative.

X-ray of dorsal and lumbar spines — Nil abnormal.

Lipiodol was put in and it showed a partial block at the level of the sixth dorsal vertebra.

Under Intratracheal gas and oxygen supplemented by local novocaine, laminectomy was performed from the level of D.5 to D.9. When the dura was opened the cord was found to be oedematous. No tumour was found in the anterior or posterior aspect. Cord was feebly pulsating. Wound was closed in layers. Patient's condition was the same as before the operation for some time. Subsequently he became worse with bed lesion of the cord; the sudden onset of symptoms of spinal shock passing off after some time, slight improvements and lipiodol examination all tended

spinal shock passing off after some time, slight improvements and lipiodol examination all tended towards the diagnosis of a spinal vascular thrombosis. Naevi of the skin the common association of which with spinal vascular abnormalities has been described by Mason (1943) were absent in this case.

The patient died four months after operation and a partial autopsy showed the following interesting condition in the spinal cord.

Patient expired on 24-7-1947.

*Autopsy:* Partial autopsy was done two hours after death. The cord was exposed along the original incision. The dura was densely adherent to the cord over the site of operation, and the dura below was distended and tense with C.S.F. The dura on incision revealed a fusiform swelling of the cord lying between the 9th and 10th dorsal nerves. The Subarchnoidal vessels below this level were congested. The cord was removed (D2 to filum terminale) Section though the fusiform swelling shows a dilated cystic space 4 mm. in diameter about 2 cm. in length rather eccentrically situated near to the left of central canal. Postero-lateral to this is seen a cleft with dark yellowish pigment. (The specimen is in the Madras Medical College Museum.)

*Microscopic appearance* shows a large cavity with no definite ependymal lining with Haemo-siderin pigment along the wall. Another cavity is seen on the postero-lateral aspect and a few more micro-cystic spaces are seen in the posterior columns on the Right side.

### A resume of other cases in the hospital and the mofussil.

As far as can be ascertained there had been in this hospital one case of extradural fibroma in a male, aged 20 (1935), a case of hernia of nucleus pulposus in a male in the lumbar region (1942), a case of intradural lipoma between L 4 and 5 in a male aged 15; a case of intra dural neurofibroma in a male aged 45 and a case of fleshy tumour, a large neurofibroma of the cauda equina, (1940) in a middle aged male under four other surgeons of the hospital.

There was a case of extensive arachnoiditis in a male after an operation under spinal percaine light solution. One case with 900 mg. protein in C.S. Fluid refused operation and went away from the medical wards. Two other male patients who were submitted to operation as tumour suspects did not reveal any tumour. One of them

proved to be an intramedullary Haemangioma at autopsy.

Four specimens of tumours of the cord were received during the past three years from two mofussil centres and they were (1) intra dural meningioma of 4th dorsal in a male aged 14; (2) sarcoma at 8th D in a male aged 50; (3) intra dural neurofibroma of groundnut size in a male aged 22; and (4) lymphangio-endothelioma in a male aged 25. This does not include cases of two other teaching hospitals of this province.

#### A resume of other specimens in the Pathology Museum.

There is an undated autopsy specimen of a spinal cord with a tumour — glioma. In the lumbar region of the cord there is an oval whitish rather firm mass of the size of an arecanut. This is seen to grow from one of the nerves arising from the spinal cord at this region, is freely movable and is covered by pia-arachnoid. It is connected to the spinal cord. Microscopically section showed spindleshaped cells and triangular cells with fine processes — glioma. There is an autopsy specimen of a spinal cord (autopsy 13-8-45) with multiple neurofibromata. On the left side the lower four roots have neurofibromata; on the right side the two lowest roots; they are  $\frac{1}{2}'' \times 1\frac{1}{3}''$ ; most likely the nerves are involved for longer distances. There is a bulge under the dura between 10th and 11th roots and an inch above this there is an intra-dural tumour. Above this there is a narrowing of the cord and an inch above that there is an intra-dural bulge. There is a neurofibroma of the right fourth root. The clinical history in this case is: A male aged 40 was admitted on 6-8-45 in the medical wards for continuous fever of fifteen days duration with rigors and chills; there were numerous tumourlike masses all over the body: he died on the same day and an autopsy was done on 13-8-45. There was a cystic tumour with haemorrhages adherent to the under-surface of the liver and upper pole of the right kidney: the

right supra renal was absent—a supra renal tumour. The spinal cord showed multiple neurofibromata.

The photo shows the tumours in the specimen (Fig. 9). It would have been

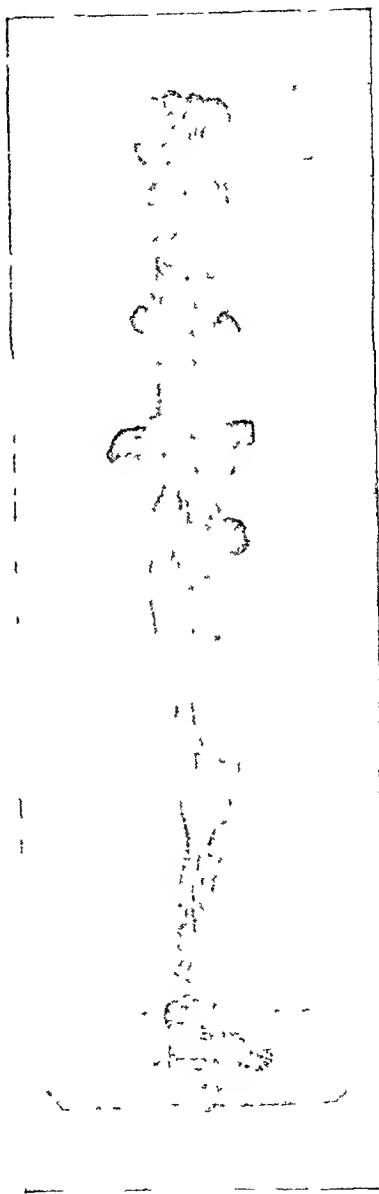


Fig. 9.

Autopsy specimen of cord from the pathology museum of the Madras Medical College  
Multiple Neurofibromata.

difficult in this case to demonstrate the various tumours at different levels; if there was not a central line tumour there need not be much of hold up of lipiodol. It would be always well to know the lower levels of tumours. In my experience I had no pre-operative knowledge of the length of the tumours an ascending lipiodol from the lumbar region and X-ray examination will be of value also. Otherwise some of the tumours will be missed.

## DISCUSSION

Classification of primary spinal tumours for purposes of convenience is usually according to their site—1. Extra dural. 2. Intra dural (a) extra and (b) Intramedullary.

The general incidence of spinal tumour is much less than that of the brain — 1.9% of spinal to 9.1% cerebral tumours of admissions to National Hospital, Queen's Square. Elsberg had 175 cases in 14 years (12.5 per year). No special sex incidence has been remarked (all the cases noted in this series, however, are males). They may occur at any age, but are usually seen in the prime of life, (this is so in this series also) and differ from intracranial tumours in their comparative absence in children. In Elsberg's series 84% of the total fell between the years 21 — 69, the highest incidence (27%) being in the 5th decade. Only one was seen in the first decade. The relative frequency of the different types of tumour may be judged according to the site e.g. over one half of spinal tumours are intra dural extramedullary about 1/5 are intramedullary and the remainder are extra dural. Since there is a relation between histological type and tumour position, the frequency of the histologic types can be accordingly assessed. Intradural extramedullary tumours are usually fibroblastoma, meningioma, fibroma or neurofibroma. Sarcoma seldom appears primarily in the cord, while the commonest intramedullary tumour is the glioma. There is a remarkable difference in the incidence of glioma in the cord and in the brain so

that the cerebral triad of astro-cytoma, glioblastoma and medulloblastoma take a small place in cord tumours. The commonest cord tumour is ependymoma (more than 50%) which is a rare brain tumour. In this series of 7 cases (all males) there were 3 Neurofibromas, one meningioma, two fibroblastoma and one glioma.

*Clinical pathology:* Symptoms produced are due chiefly to pressure which varies according to the size and situation of the growth.

*Effects on neural parenchyma:* An intramedullary tumour must of necessity destroy neighbouring tissue as it enlarges, the damage decreasing in proportion to the distance from the growth. An extramedullary tumour seldom invades the cord, but pushes it aside as far as the anchoring nerve roots will allow. Tumours on the dorsal aspect of the theca have less pressure effects than anterior ones, as there is more space in the posterior half of the spinal canal. Tumours attached to spinal roots first irritate and then destroy the nerve fibres.

*Effects on blood vessels:* Tumours outside the cord interfere with its blood supply. There is first engorgement of meningeal and spinal vessels and later ischaemia which leads to necrosis.

*Effects on C.S.F.:* The first pressure effect is failure to transmit the respiratory and cardiac waves so that there is no pulsation. In a fairly complete block, the pressure below the compression will fall but in rare cases it may rise due to venous transudation. The changes in the C.S.F. are not specific and do not definitely establish the presence of a growth. These changes are (1) altered composition; (2) interruption of the free flow of the fluid. *The change in composition occurs early even before clinical block is manifest.* The chief feature is protein increase from the normal 35—40 mgm. to 100—500 mgms. or even more. One case of 3600 mgm. was reported by Spurling and Maddock. Intramedullary growths cause less protein increase than extramedullary and the same figures may be

obtained from a cervical as from a cauda equina lesion. Protein increase alone is characteristic though not pathognomonic of cord tumours.

Other, less important changes in composition are a yellow colour and spontaneous coagulation. This group of changes should not be called Froin's syndrome which also includes pleocytosis and which is seldom found in tumour compression due to adhesive meningitis.

Hindrance to the free passage of the fluid is proved by manometry. The normal pressure is 100—150 mm. of water, but may vary 20 mm. either way, so that any figure less than 80 below the seat of obstruction is pathological.

Pure manometry is not of much clinical value unless there is a complete block and in practice it is found that Queckenstedt's test is much more useful. This should be carried out with the patient in the horizontal position on his side with a manometer attached to the needle, allowing an appreciable interval for the fluid to settle down. Mere touch on the jugulars will now send the pressure up by 10 mm. and maintained pressure will increase it by 200—500 mm. On releasing the pressure, the fluid comes quickly and evenly down to the previous level. When there is partial or complete subarachnoid block—the fluid does not move freely or smoothly in response to jugular compression, takes a longer time to reach its maximum level and lingers in its descent.

- (1) The rise may not occur at all.
- (2) It may rise at the most 50 mm.
- (3) The ascent is slow.
- (4) The top level is maintained for a space after compression is released.
- (5) The fluid sinks slowly or by steps and does not reach the previous level.

A complete manometric test should include a record on an appropriate chart of:

- (a) the effect of light touch compression on the jugular veins.
- (b) the effects of firm compression for 10 seconds.
- (c) the time required for the rise of the column of fluid to its highest level.
- (d) the time required for the fall after deep compression has been discontinued.
- (e) the level to which the fluid falls.
- (f) the effects of straining.
- (g) the level to which the column of fluid falls after 7.5 c.c. of fluid has been allowed to escape. (Fig 10 shows the manometric chart in an extra dural block.)

The same type of test may be carried out by raising the intra cranial tension with inhalation of amyl nitrite glass pearls containing 5 mms. of amyl nitrite. One pearl is broken and inhaled for 30 seconds by passing it from side to side under the patient's nose. Manometric readings are taken every 5 seconds during inhalation and thereafter till the pressure had fallen to the pre-inhalation level—usually 3 to 4 minutes. Inhalation is begun during inspiration. When there is a block in the subarachnoid space the jugular test shows:

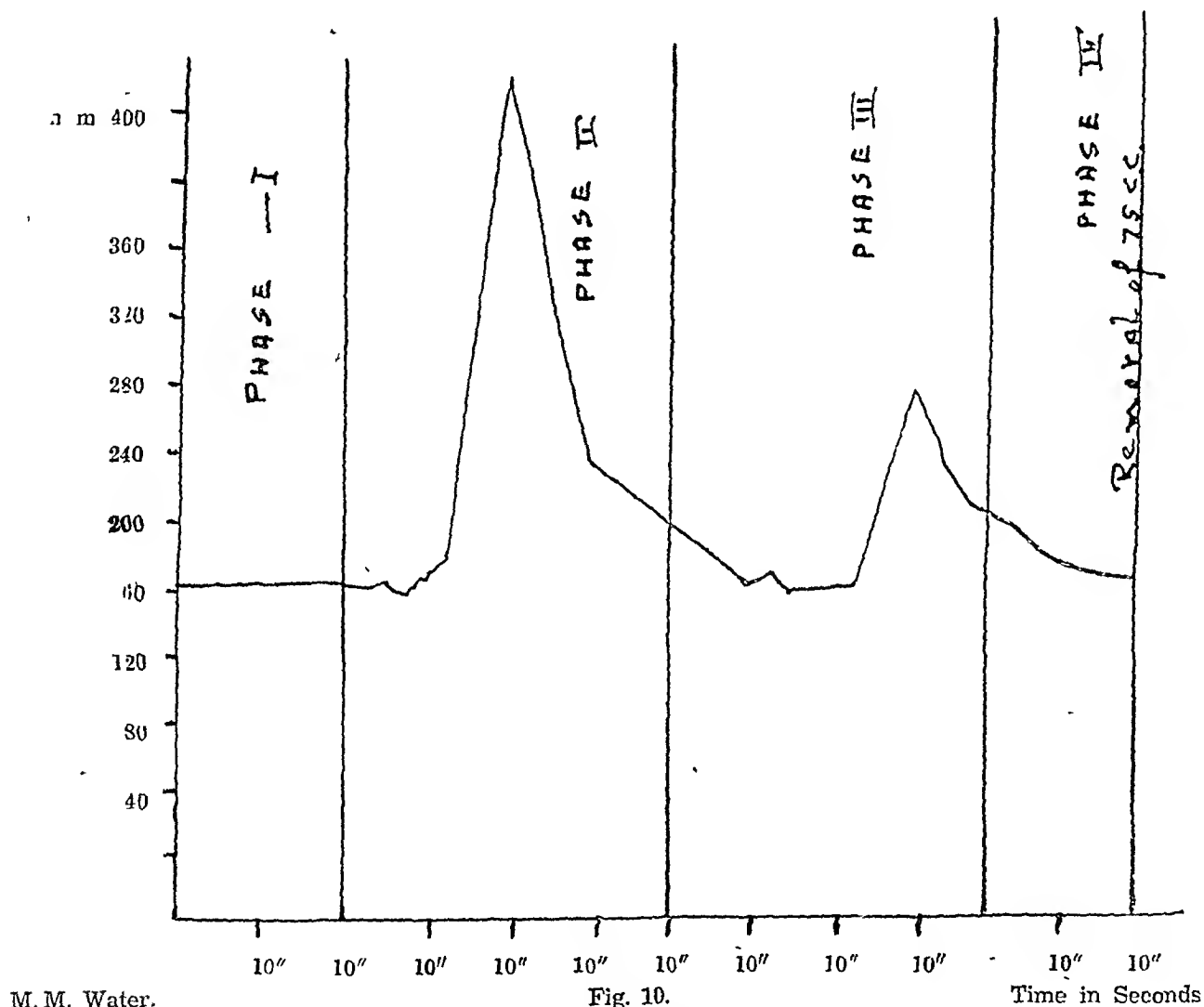
- (1) Complete block when there is no rise of the fluid on both touch and deep compression, and when after removal of 7.5 c.c. of spinal fluid—the fluid does not fall to a new level.
- (2) Partial block (a) total rise of the column of fluid of less than 100 mm. and a rise of the level *during* inhalation of the drug, 20—30 mm. (b) a rise of between 100—105 mm. and a total rise *during* the period of inhalation of the drug of not more than 20 mm. and a delay in the beginning of the rise of at least 10 seconds (Elsberg).

*Symptoms* vary considerably with the size and especially, longitudinal extent of the growth. On the other hand a tumour



may be long but its thickness may vary in different parts, so that different parts of the growth may exert a varying amount of pressure or only one part of the tumour may actually compress the cord. This accounts for the marked variation seen in the combination of symptoms. A tumour

lying over certain segments of the cord, may not actually involve all those segments so that the signs produced may not extend as high as the tumour itself. This accounts for the discrepancy between the level of signs of some growths and their exact location.



Manometric Chart in an Extradural Block.

Note the delayed rise which is characteristic.

In an average case however the symptoms are (a) local symptoms at the level of the tumour and (b) concurrently or soon after, symptoms below level of lesion due to pressure on tracts irrespective of whether spinal tissues are compressed from within or without.

1. *Sensory root symptoms.* Root pain is the earliest and most frequent symptom. It may involve one or more roots and is more commonly noticed in fibroblastoma (Case No. 2). Local spinal pain, tenderness and soreness over the site of the tumour is often noticed, especially in cauda equina lesions (Case No. 3).

Various explanations of this pain, such as irritation of nerve filaments, have been put forward but lack conviction. Sensory root symptoms appear more often because fibroblastoma generally lies on the dorsal or dorsolateral aspect of the cord.

2. *Sensory cord symptoms.* Tumours growing inside the cord do not produce root pain but a central type of pain referred to a whole limb may occur. Paraesthesias when due to a cord lesion often begin in the periphery, e.g. ascending from toes to trunk in steps. In some cases the Brown Sequard syndrome is found.

In many cases there is a combination of sensory and cord symptoms, a fibroblastoma usually causes root symptoms first while a glioma causes cord symptoms first.

3. *Motor root symptoms* are irregular in appearance are not early and do not show till more than one root is affected. The first sign is weakness of a group of muscles leading to atrophy a moderate progressive lower motor neuron lesion and has a prime localising value.

4. *Motor cord symptoms* are due to derangement of pyramidal tracts by compression, e.g. a monoplegia or paraplegia. In many cases there are motor root symptoms at the level of the lesion and motor cord symptoms lower so that it is possible to assess the site of the lesion.

5. *Reflexes.* Tendon reflexes are exaggerated below the obstruction. Organic reflexes depend on the situation and evolution of the tumour. If above the lumbar enlargement, the bladder may become automatic or overflow from fullness. Only if the vesical centres in the cord are damaged does dribbling incontinence occur.

6. *Trophic lesions* may be due to neurosympathetic damage and predispose to bedsores. Trophic ulcers over the sacrum, buttocks and heel are common in lumbosacral and cauda equina lesions but are very rarely seen in lesions of other parts of the cord, e.g. cervical and thoracic. In these cases it is extremely rare to find trophic

disturbances unless the skin has been injured. This contrasts markedly with what may happen after operative interference where there may be a certain amount of acute trauma to the cord. Case 1 illustrates this fact.

The cases presented in this paper have several interesting features.

1. Their ages were 35, 25, 29, 31, 42, 60 and 40 except one all in early manhood—all being males.

2. *The symptoms varied in each case—*

(a) Case No. 1 showed a cord type of lesion. He had no root pain, but had local pain over the site of the tumour. The extensive nature of the growth explains the widespread paralysis which did not recover with decompression.

(b) In Case No. 2 the patient came in an advanced state of paraplegia which was mistaken for spinal syphilis because of a positive Wassermann result and the presence of cells in the C.S.F. C.S.F. protein was 600 mg. %; Xanthochromic but no clotting was present. The earliest symptom was root pain, followed by ascending paralysis in the lower limbs, and finally disturbance in bladder and rectal functions; a band of hyperaesthesia at the level of the nipple helped to fix the level of the lesion. The nature of the growth (fibroblastoma) might have been presumed from the clinical history of root symptoms followed by cord symptoms, while central glioma produces first cord and then root symptoms (Elsberg).

(c) In Case 3, the only symptom was severe root pain and local tenderness over the spine combined with gluteal wasting so that this patient might have been overlooked as sciatica, if he himself had not insisted on obtaining relief. C.S.F. was yellow with 100 mg. protein but no spontaneous coagulation. The large soft tumours of the cauda equina (as in this one) often fill the entire lower end of the spinal canal and cause very slowly progressive symptoms for several years. They often exist

without any objective sensory symptoms and may cause only motor disturbance. In this case the only signs were root pain (subjective sensory) and gluteal wasting (motor) on the contralateral side. There was at first a mistaken diagnosis of tuberculosis of the spine.

(d) The 4th case came with paraplegia with positive Wassermann mistaken for spinal arachnoiditis. A high protein content 1500 mg. % with 3 cells was the decisive feature in introducing lipiodol to demonstrate the block. The case was treated as spinal syphilis for a long time.

(e) The fifth case was one of increasing disability with marked irritative symptoms which had been diagnosed at various times in the course of 12 years as peripheral neuritis, ichthyosis, progressive muscular atrophy and disseminated sclerosis. The C.S.F. protein was 80 mg. % on the first L.P. as early as twelve years ago and should have aroused the suspicion of a spinal tumour. Trophic lesions set in in this case for the first time after operation.

(f) The sixth case had severe root pains with a localised tumour which was partially excised elsewhere and proved to be a neurofibroma with extensions into the vertebral foramina and intercostal nerves.

(g) The seventh case was also treated for Syphilis.

3. *The C.S.F. findings* in these seven cases are also worthy of notice. In every case lumbar puncture was performed between the 3rd and 4th spines. In all the cases the fluid was apparently not under pressure, and did not clot except in the 4th and 5th cases. In the first 4 cases fluid was Xanthochromic. Only in Case No. 2 were there cells, and this contributed to an erroneous diagnosis of spinal syphilis. The protein excess was remarkable in all cases excepting No. 1.

In the case of hypertrophy of the ligamentum Subflava, the lipiodol radiogram was not characteristic. In Case No. 8, one of the two cases of compression syndrome

where no tumour was detected during the operation, there was a strong suggestion of a Syphilitic lesion; the difference in the protein contents of C.S.F. obtained by cistern puncture and by L.P. and the partial hold up of Lipiodol however made the diagnosis of tumour reasonably certain. The other Case No. 9 showed a progressive increase of C.S.F. protein from 40 to 60 and 80 mg. % at intervals of a month and a difference in protein between cistern C.S.F. and L.P.C.S.F. (30 mg. and 80 mg.) and though there was no hold up of Lipiodol, a spinal exploration seemed to be indicated.

There is a considerable literature on vertebral angiomas but not on vascular lesions of the cord. Many cases of paraplegia till now included under the term Myelitis are probably examples of vascular abnormalities.

R. Wyburn Mason (1943) has classified the vascular abnormalities in his book and described typical clinical syndromes with notes on the pathology, verified in many cases, at autopsy. Sixty seven cases are described fully with operation and, in some, autopsy notes. The operation findings are instructive and will repay careful study by all those interested in spinal tumours.

186 cases of vascular lesions have been described in the literature so far. Wyburn Mason's classification and a few relevant facts under each condition may be of interest and are reproduced below:—

#### (A) abnormalities:

- (1) a. venous abnormalities below a tumour of the cord.  
b. extensive venous varicosities.
- (2) arterio venous angioma.
- (3) arterial abnormalities associated with congenital heart disease or alone.
- (4) syphilitic aneurysm of spinal arteries.
- (5) Telangiectasis cavernous angiomas.

## (B) True tumours:

- (1) (Haemangio-blastoma or Haemangio-endothelioma) which may be extra dural or intra dural.
- (2) Lymphangioma.

The frequency of vascular lesions may be judged by the fact that Adson found that of 557 intraspinal lesions, 8.5% belonged to the group of extramedullary vascular tumours and that of 64 intramedullary tumours, 7.5% were vascular in nature.

Enlargement and engorgement of veins occur below the tumour due to the obstruction to the venous circulation, whenever pressure occurs in the cord from an intraspinal or vertebral tumour. A similar enlargement and engorgement occurs in association with arachnoiditis or arachnoid cysts, but is probably caused by venous obstruction caused by kinking of the vessel walls: calcification occurred in the cord following trauma in a case and this was associated with enlargement of veins.

Angioma racemosum venosum is the commonest type of vascular abnormality of the cord. It also seems to be associated with tumour in 3 to 4% of cases. Adson & Otto met it three times in 112 laminectomies for spinal tumours, and in 4 more it was found at autopsy.

78 cases are described of this type. The pathological effects are seen in the lower part of the cord and in no case has it extended higher than the D 6-5 segments. On reflecting the dura the lower part of the cord is usually seen to be covered on the dorsal surface by a mass of sinuous anastomatic, turgid, blue pial veins. They are often in two layers and completely hide the cord. On microscopic section of the involved regions abnormal vessels are seen extending from the anterior median fissure into all parts of the grey matter and white matter adjacent to it. The nervous tissue is replaced by numerous blood vessels, chiefly capillaries, precapillaries and venules, which destroy the cells of the grey-matter and cause

degeneration of white-matter with considerable gliosis in many cases.

The course, sex, age incidence, C.S.F. changes and pathological changes are identical in acute necrotic myelitis and angioma racemosum venosum. The first appearance of symptoms is due to thrombosis occurring in one or more vessels and the characteristic progression of the condition in successive waves corresponds to the occurrence of successive thromboses. Trauma may initiate the thrombotic process; operation will be of no benefit to these cases.

*Characteristics of the disease* are discontinuity of symptoms and progression a series of apoplectiform stages or "episodes" at first possibly with almost complete recovery between the attacks, but, sooner or later, permanent symptoms. All these manifestations occur below the middle of the body. In 3/5 of the cases the onset is sudden acute pain of a root type, either the lower portion of the trunk or the legs. Commonly it is diagnosed as Sciatica; this pain may be severe and is a prominent feature of the illness, may disappear and come back, and is possibly due to the pressure of the engorged veins on roots. Pain varies when the patient moves from the horizontal position and is completely relieved by standing up. The onset of the pain is associated with weakness or complete paralysis of one or both legs, numbness and paraesthesia in part or whole. Sphincteric disturbances may be present. Symptoms come on rapidly. Sensory losses of the dissociated type pain and temperature being affected, while appreciation of posture, vibration and touch are well preserved; but sometimes they are slightly disturbed also. At this acute stage of spinal shock the deep reflexes are usually diminished or lost in the affected limb or limbs; but after a short time when the shock has passed off another characteristic finding of the disease, namely, flaccidity and wasting of some muscles with diminution and loss of tendon reflexes, spasticity and increase of reflexes in other segments of the limb,

extensor plantars and loss of abdominal reflexes appears. Thus there is a mixture of upper and lower motor neurone disturbances in the lower limbs. The commonest muscles to waste are those of the buttock, calf and hamstrings on one or both sides. After the stage of spinal shock has passed off the sphincter disturbance often improves and may disappear. At autopsy thrombosis of the dilated and abnormal vessels are found.

*Associated Lesions.* Vascular naevi of the skin have been present in several cases. In one case the naevus was in a skin dermatome on the back corresponding with to the cord lesion.

*Course.* In the 16 patients dying without operation, the course varied from 3 months to 24 years, the average being about 7 years. This is much longer than the course of most spinal tumours, but some cases run a very rapid course in 3—6 months.

*C.S.F. Examination.* By lumbar puncture in 17 out of 32 cases the fluid was normal; in some cases there were 11 to many lymphocytes during the time of the episode; the lymphocytosis is probably evidence of a recent thrombosis in the affected veins and tends to occur in the more acute cases. In 36 cases there was an increase in the protein from 90 mg. to about 1500 mgs. %. In several cases spontaneous coagulation occurred. The amount of protein is unrelated to the presence of block in the subarachnoid space. Xanthochromia was present in 12 cases only. This may be found whether block is present or not and it is unrelated to the amount of protein in the fluid. Queckenstedt's test was positive in 5 cases, i.e., the pressure did not rise, and was negative in 19 cases. Of 5 cases of cistern puncture, in 2 C.S.F. was normal and in 2 cases the protein was increased in the absence of shock. Lipiodol intrathecally was performed in 19 cases. In 10 cases there was no hold-up whatever. The appearance resembles in some ways that seen in spinal arachnoiditis; the oil is held

up over several segments of the cord, either completely or partially in the form of small droplets.

30 cases of arterio-venous angioma are described. Sex incidence is almost equal; in most patients the first symptoms appeared early in life but often no great disability occurred until much later. Two regions of the cord are specially affected, the posterior portion from the 7th thoracic to the upper lumbar segments, and the anterior portion of the cervical enlargement; one side may be more severely affected than the other. During the lipiodol examination visible pulsation under the X-ray screen and by Kymography may be noted. This appearance is only seen if the patient is slowly moved from the horizontal position; if the movement is done rapidly the oil may drop too quickly and the pulsation and hold-up missed.

Six cases of arterial abnormalities are described. The cases in which spinal cord compression is associated with congenital heart diseases are of two kinds. (a) those associated with coarctation of the aorta (b) those associated with some type of congenital heart disease; the spinal arteries are affected on account of the collateral circulation giving rise to tortuosity and enlargement of those vessels.

A careful clinical and radiological examination of the heart, where an obscure spinal cord lesion is present is therefore necessary.

Similar to spontaneous intra cranial sub-arachnoid haemorrhage, spontaneous spinal sub-arachnoid haemorrhage also occurs; it may occur suddenly without previous syndrome or during the course of a progressive spinal lesion or as a terminal event. Telangiectasis, both intra medullary and epidural has been described. There is relationship between this and the multiple hereditary telangiectasis. There is association of telangiectasis, lipomata, meningiomata, osteoma and skin naevi indicating a disturbance of mesenchymal development.

Haemangioblastoma and multiple angiomas have been described; this is twice

as common in males as females, when the cord is affected; the average age is 32—the youngest being 9 and the oldest 58 years. The age incidence is almost entirely in the third, fourth and fifth decades. (Mason)

*Operative technique:* The first case was operated on under intra-tracheal  $C_2E_3$  but the other two were given rectal ether in oil supplemented with light ether inhalation and combined with local nerve block with  $\frac{1}{2}\%$  solution of novocaine. The other cases were done under intratracheal gas and oxygen combined with local novocaine. This anaesthesia proved very comfortable for patient and surgeon and there was very little operative shock.

In removing the laminae, especially in the thoracic region, it was found that the removal of both spines and laminae is easier in a cephalad direction. This is because the thoracic vertebrae are more fixed and the spinous processes and laminae overlap. In all the cases it was noticed that there was a distinct narrowing of the cord above the growth so that an hour-glass like appearance was noticed. In cases Nos. 2 to 6 the tumours extended more anteriorly than posteriorly, so that the cord had to be deliberately turned and the anterior aspect inspected. The tumour in case No. 3 (cauda equina) and 5 and 6 would have been missed if this had not been done, as they were completely anterior and were covered on the posterior aspect by the nerve roots.

The prognosis of a case submitted to surgery depends on the following points:

- (a) The nature of the growth.
- (b) The stage at which the surgeon interferes, and
- (c) The amount that he is able to remove.

Case No. 1 showed no improvement, the growth was an extensive neuro-fibroma about 4–5" long producing erosion of the vertebrae on all aspects and widening of the spinal canal—proved fatal on account of paraplegia and extensive trophic lesions.

Case No. 2 has recovered considerably and it is hoped that the recovery will be complete, as though late the tumour (a benign one) was completely removed.

Case No. 3 shows the best prognosis as the tumour was completely removed at an early stage. At present, the root pain has completely disappeared but sensation over the sole of the left foot is impaired.

The fourth case has improved. Spasms have completely disappeared. Paraplegia is recovering. He has been fitted with boots and irons to prevent foot-drop and he is on his legs with crutches.

The fifth case showed initial improvement. The spasms did not entirely disappear although it was 80% better. He was able to pass urine but rectal sphincter was very lax and he had pressure sores over the right trochanter.

The sixth case proved fatal on account of bilateral pneumonia, finally he succumbed to the effects of extensive bed sores.

The seventh case had a smooth post-operative course; but there was no improvement in function.

*Diagnosis of early cases.* In considering these cases one notices that the progress of symptoms is slow, and one is stimulated to look for some method of diagnosing cases in the very early stages. C.S.F. changes and pressure symptoms on root and fibre tracts can presumably occur only after a long time and the aim should be to diagnose these conditions even before pressure symptoms occur. In this endeavour it is useful to consider a few anatomical facts.

1. In the cervical region the nerve bundles remain distinct until they have passed through the dura, the bundles originating from the cord being spread out like a fan with the broadest part at the cord. The dorsal and lumbar roots are formed by nerve bundles which soon unite to form the root that passes as one bundle to the dural opening. From this arrangement in the cervical region a tumour may for a long time press upon only a few of the bundles

which compose the root, while in the thoracic and lumbar regions a tumour may from the beginning press on the entire root.

2. Normally the spinal cord is mobile both in longitudinal and transverse directions. In abnormal conditions movements of the spine may produce disturbances both in the fixed part of the cord and in the affected nerve roots, so that part of the spine is unconsciously held rigid. This stiffness of the spine is often a defensive reaction on account of radicular pain. These facts should be borne in mind in the diagnosis of back-ache and suspected cases of spinal tuberculosis.

3. During forced expiratory movements such as sneezing, coughing or straining, the mobility of the cord and the potency of the sub-arachnoid space is sufficient to prevent any radicular disturbances. When the C.S.F. is expelled from the cranial cavity into the sub-arachnoid space, when the cord is fixed by disease, or the sub-arachnoid space is partially or completely obstructed, the sudden passage of C.S.F. into the spinal sub-arachnoid space results in the sudden stretching of the posterior spinal roots at the affected level and as a result, sudden pain in the back or pain of radicular distribution occurs. In an expanding lesion of the spinal canal, the pain on forced expiration may be due to the sudden impact of the tumour on a posterior spinal root.

4. The arrangement of nerve roots are as follows:—

(a) The cauda equina. The most medially situated are the lower sacral roots, the lumbar being more laterally placed. Many cauda equina tumours spring from the mesian filumterminale.

(b) The posterior white columns. The fibres from the sacral areas lie nearest the middle line and most ventral, while the fibres from areas above the sacral take their position outside of and posterior to the sacral fibres.

(c) The pyramidal tract. In the antero-lateral column the fibres have a lamellated

arrangement, those supplying muscles at a higher level lying more medially to those supplying muscles at a lower level.

5. The spinothalamic pathway. The crossing is immediate in the same cord segment. There is lamellation of fibres in the spinothalamic pathway. The fibres which convey sensation from the most caudal skin areas lie in the posterior and outer parts of each tract, and those which join at higher levels, take a position somewhat anterior and internal to the ones already in the tract.

Bearing these facts in mind it is possible to lay down some principles in the early diagnosis of spinal tumours:—

1. In the absence of other disease, a persistent neuralgia must always be looked upon with suspicions that the pain may be of spinal root origin (Elsberg).

#### FIRST SYMPTOMS OF 64 cases OF SPINAL TUMOUR (Table modified

from Ayer (Kinnier Wilson)

SYMPTOM	TYPE OF GROWTH		
	Intra-medullary	Extra-medullary Endothecal	Extra-dural (vertebral)
<b>SENSORY</b>			
Root pain ...	6	18	1
'Spinal pain' .	7	5	—
Paraesthesia	5	5	2
<b>MOTOR</b>			
Weakness or paralysis...	2	13	4
Spasm or trembling ...	2	—	1
Unsteadiness ...	—	3	—

The patient may have to be observed for a long period as it often requires a long time for cord symptoms to appear.

2. If coughing, sneezing or other forced expiratory movements aggravate the neuralgia the possibility of a spinal root lesion is considerably nearer.

3. Cutaneous hyperaesthesia of a radicular type points to a spinal root origin of

the pain, especially if coupled with muscular atrophy of the radicular type (Case No. 3).

4. In cases where neuralgic pain is the only symptom, careful search should be made for slight sensory or motor disturbances below the lesion. If tendon reflexes are found to be more active on the same side as the root symptoms, *no matter how slight*, the diagnosis of a growth in the spinal canal is probable.

5. When radicular neuralgia is diagnosed and found to persist or worsen examination

are most useful for determining this. According to Elsberg and Dyke the width of the spinal canal corresponds accurately to the space between the most medial borders of the vertebral pedicles. Generally speaking, the more localised the enlargement of the spinal canal, the more likely it is to be due to a pathological process.

7. Lipiodography. Elsberg states that lipiodography is resorted to more frequently than necessary because the spinal manometric tests are not carefully carried out with full appreciation of the time element, so that partial sub-arachnoid blocks are

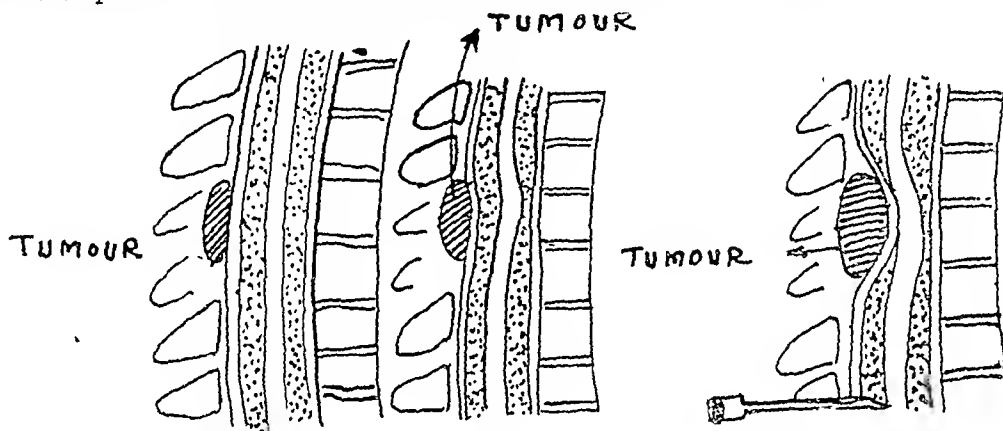


Fig. 11.

Schematic Drawing showing relation of an Extra Medullary Tumour to the Spinal Cord after removal of the Fluid Buffer.

of the spinal fluid with manometry as detailed here is equally important as X-ray examination and a complete examination of the patient should be *recorded* before and after the lumbar puncture. In this way indefinite level lesions may become more evident, or existing signs be aggravated.

6. X-ray examination must always be made carefully in the diagnosis of early cases, for hitherto unsuspected bone disease. The measurement of the interpediculate spaces should never be omitted. The interpediculate distance is the space between the most medial points of the pedicles of a single vertebra. X-rays of the spine taken in the antero-posterior position

missed. He opines that in all cases careful spinal manometry will give all information without having recourse to cistern puncture or lipiodol. He also states that even in the hands of experienced surgeons he has known of several cases where bleeding occurred into the fourth ventricle after cistern puncture.

When using lipiodol the light solution should never be used as a considerable amount may enter the cranial cavity and find its way into the intracranial fluid spaces. The heavy solution (40%) may be removed by making the patient sit vertically, making a burr hole in the arch of the 2nd sacral vertebra, and withdrawing the oil by suction.



**Differential diagnosis:** The early signs of spinal cord tumours are determined largely by the position of the neoplasm in relation to the cord and emerging nerve roots. A tumour arising from a nerve root may give symptoms referable to the nerve root long before there is any evidence to suggest spinal cord involvement.

In early involvement of nerve roots within the vertebral canal without obvious compression of the cord, the early signs are referred to the peripheral distribution of nerve roots and the symptoms may be confused with those referable to disturbed functions of the kidney, gall-bladder, appendix, prostate, etc. 8th cervical root gives pain in the hand, 4th thoracic root may cause pain in the breast while lesion of the 7th and 8th thoracic roots on the right side simulates a lesion of the gall-bladder.

A tumour on a nerve root may exist for a long time without producing definite sensory changes referable to the root involved or if the tumour arises from the motor root before it has joined the sensory root, the earliest sign may be atrophy, fibrillary twitchings and weakness of the muscles supplied by the root. If both sensory and motor roots are involved there will be sensory and motor disturbances and atrophy appearing in the region in which pain is felt. (Fig. 12-A)

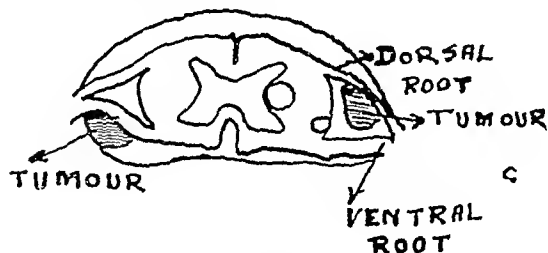


Fig. 12a.

Extra medullary cord tumours may present two groups of symptoms, the long tract syndrome (Fig. 12-C) and the root syndrome, either or both of which may be present.

Intramedullary tumours present the so-called central grey syndrome (Fig. 12-B) which is a combination of bilateral radicular

symptoms and the symptoms of long tract compression. Tumours of the cauda equina are large soft jelly like masses surrounding the nerve roots and producing radicular signs. It is important to note that on account of their soft jelly-like consistence,

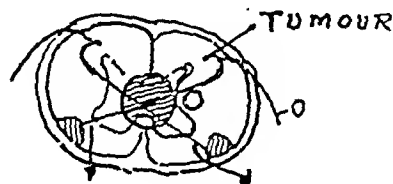


Fig. 12b.

Crossing Fibres to Spino Thalamic Tracts.

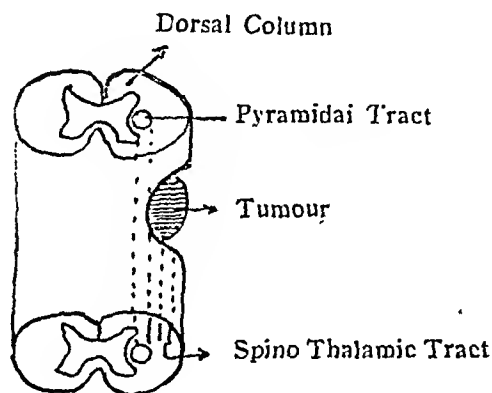


Fig. 12c.

Schematic diagram to show the relation of Tumours to the Spinal Cord and the Nerve-roots of the Long Fibre Tracts.

- A. Radicular Syndrome.
- B. Central Gray Syndrome.
- C. Long Tract Syndrome.

pressure may be exerted on the roots for many years, with only vague signs to suggest the presence of a tumour (Case No. 3).

Because of their symptoms, intramedullary tumours have frequently been mistaken for chronic poliomyelitis, syringomyelia or some other form of intrinsic disease of the spinal cord. Most chronic intrinsic diseases of the spinal cord do not materially increase the size of the cord or make it fill the vertebral canal within whose rigid walls it is enclosed. Spinal cord tumours are expanding lesions and form an obstruction like a dam which obliterates the sub-arachnoid space, preventing the flow of the spinal fluid. Intrin-

sic diseases do not cause obstruction of the sub-arachnoid space, block of the spinal fluid or compression of the cord itself. The lesions producing sub-arachnoid block are spinal cord tumours, inflammations, both acute and chronic, displacements of the vertebrae, or intervertebral discs and hypertrophic arthritis.

### SUMMARY

1. Seven cases of spinal cord tumour are described in detail; other cases of this hospital and specimens received by the Pathology department are mentioned.

2. One case of hypertrophy of ligamentum subflava is described.

3. Two cases diagnosed as spinal cord tumour are described where no tumour was detected. These two cases may be classed as vascular lesions of the cord producing compression syndrome.

4. An attempt is made to emphasize a few points in the early diagnosis of cord tumours.

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## PERITROCHANTERIC BURSTITIS

by B. N. BALAKRISHNA RAO, *Basavangudi, Bangalore, S. India.*

### Introduction

Disabilities of the inferior extremity could be of serious import, even though the causative pathological processes by themselves may be mild. Disabilities round the hip are numerous, (excluding those of the joint and the bones) but have been paid little attention, probably on account of the fact that they do not cause the same degree of active or serious loss of earning capacity, as in the case of the disabilities round the shoulder. Consequently the disabilities round the shoulder have received greater study, while similar changes round the hip have been unnoticed. In the inferior extremity the diseases of the hip and other joints have so dominated the field, that minor disabilities have been overshadowed to some extent: none the less these disabilities are real and cause considerable pain and discomfort and diminish the efficiency of the person.

In this paper one such disability is described with a few unusual features that came under our notice.

Bursae are to be found in many parts of the body: due to irregular contour of bones or oblique lines of force, or where one structure has to rub over another and a smooth movement is desired bursae are present. Many are present at birth, a good few are constant in their position and structure, a few inconstant and variable, and a number develop as adventitial bursae. The bursae round the great trochanter of the femur are fairly constant in their position and structure, and changes in these bursae are of interest not only because they may simulate hip joint disease, but the disability these bursae produce is curable in the majority of

cases, if the pathological processes are correctly appreciated.

Chronic inflammation of bursae is of frequent occurrence, and of those round the trochanter are not usual, especially so with calcification. Nilsson reported a case of calcified trochanteric bursitis in 1930, in the *Acta Orthopaedica Scandinavica*, under the title 'Tendinitis calcificans trochanterica', and claimed that his was the first operated case reported. Although this claim is not strictly correct, it is true that in the present century this subject has received slight attention.

The meagre attention paid to this condition and the very few reported cases in the literature in English and in the prominent continental languages, prompted the publication of this paper to draw the attention of surgeons in this country.

### Trochanteric Bursae

Anatomical descriptions of the bursae round the great trochanter are rather inaccurate and not sufficiently detailed. Three bursae are almost always present in the neighbourhood of the great trochanter and are closely related to the musculo-tendinous insertion of the gluteus medius muscle. Of the three bursae, one lies between the gluteus minimus and the great trochanter, which is inconstant: another lies between the gluteus medius and the great trochanter. Often these two communicate with each other. The third bursa lies under cover of the gluteus maximus, partly overlying the insertion of the gluteus medius and partly directly over the trochanter itself. This is a large and constant bursa and is multiloculated, and very often the seat of inflammatory changes either primarily in itself or secondary to patho-

logical changes in the great trochanter which lies under it. This bursa is peculiar in that, it may be the focus of a tuberculous lesion, and may be the cause of a persistent sinus on the lateral aspect of the thigh, without the trochanter being affected. Thus a variety of tuberculous inflammation of this bursa is frequent, and it has not been explained as to why this bursa alone has a predilection for a tuberculous lesion. While tuberculous infection of the bursa as a result of spread from tuberculous osteomyelitis of the neighbouring great trochanter is understandable, it is strange that tubercle bacilli should settle down in this bursa without affecting the more vascular structures in the neighbourhood. Whatever may be the reason, it may be justifiable surmise to think that the same factors may facilitate the deposition of calcium in the bursa.

Calcification in non-osseous skeletal tissues has been the subject of great controversy and of diverse views and theories. Leriche and Policard are of the opinion that such calcification and later ossification is always the result of trauma. The trauma may have been so slight, or may have occurred such a long time before symptoms manifested themselves, that the patient may not correlate the trauma to the present complaint. According to Leriche the sequence of events are trauma, haemorrhage, organisation and at times calcification and ossification. While the trauma may be forgotten, the haemorrhage and organisation would produce symptoms not always easily forgotten by patients, and it is difficult to subscribe to Leriche's view regarding calcification. Moreover, a few bursae like the prepatellar bursa and most of the adventitial bursae, themselves the result of repeated trauma, are predisposed to repeated injury; these seldom deposit calcium. Therefore, it appears that the reason why calcification occurs in tissues should be sought in causes other than in trauma and haemorrhage. In the two cases described here, in one the onset of trouble was undoubtedly traced to an acute single trauma,

and in the other no history of trauma could be elicited after careful interrogation.

Tuberculous infection of trochanteric bursae appears to be frequent. If tubercle bacilli favour a vascular tissue for its focus of lesion (e.g. lungs, kidneys, ileo-caecal region, etc.) then it is strange that this bursa, a relatively avascular tissue should be a frequent site. The combination of tuberculous predilection and tendency for calcification may not be mere coincidence, and needs further elucidation. In the following two cases, as well as in the case of Lecocq, the investigations for tuberculosis were negative.

### CASE REPORTS

#### Case 1.

P., male, 25 years of age, unmarried, employed as a wrapper in a beedi factory was hospitalised on 14-4-45 with a complaint of swellings on the upper part of both the thighs, and difficulty of sleeping on the sides. The left swelling was of nine months duration and the right of six months. Family history was negative in relevant details. The present complaint started when about nine



Fig. 1.  
Case 1. Showing shadow of calcified bursa overlapping the great trochanter.  
(Slightly retouched)

months ago he noticed a small lump on the left side in the upper part of the thigh in the neighbourhood of the trochanter, which has gradually

increased to the size of a big orange. It was freely movable and was never painful, but he could not lie on the left side. Six months ago he noticed a similar swelling on the right side in the corresponding part, which was also freely movable, and painless.

On examination there was a globular swelling on the lateral aspect of each thigh at the level of and overlying the great trochanter of the femur. The swelling was lobulated, hard in some areas and there was a gritty feel. The skin was not adherent to the swelling, and the swelling moved freely over the underlying bone. The left swelling was slightly larger than the right.

Roentgen investigation showed a large fluffy shadow in the region of the great trochanter, and on account of its size, its relation to the trochanter could not be definitely established. The trochanter itself appeared normal. The shadows were in the soft tissue and were deposits of calcium, and there was no evidence of ossification. (Fig. 1).

No definite preoperative diagnosis was arrived at, though a probability of a calcified bursa was entertained, a calcifying chondroma could not be ruled out, even though the swelling was movable over the underlying bone.

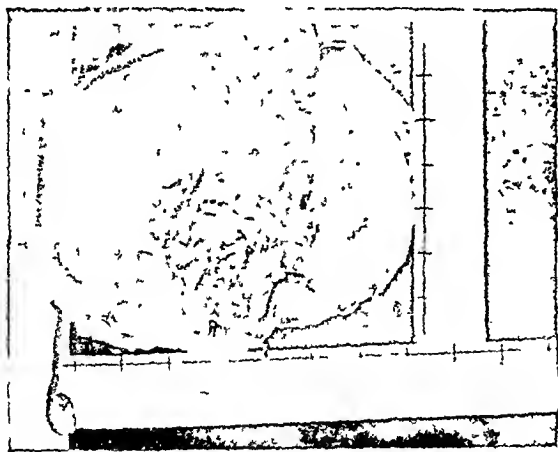


Fig. 2.

Case 1. Showing surface of bursa after removal.

Under spinal percaine anaesthesia, the left side was operated on on 16-4-45. At operation the swelling resembled a lipoma with large areas of calcification. It was well encapsulated and was removed entire. On section it felt gritty, and white thick curdy fluid, like barium emulsion escaped. Convalescence was uneventful.

#### Description of Specimen:—

The gross specimen shows a lobulated tumor 12 by 8 by 4 cms. and weighs 297 grammes. Lateral surface is convex with several fluctuant areas, some of which have ruptured. Medial surface is flattened with a slight concavity about the centre.

Tumor is well encapsulated. On section in the sagittal plane, the cut surface presents a well defined fibrous capsule, uniformly thick except for a few areas in which it is extremely thinned out and ruptured. A thick fibrous septum is seen to divide the tumor into unequal lobes. Numerous intersecting bands of fibrous tissue are seen dividing these two lobes of the tumour into several unequal and roughly spherical loculi. These are filled with opaque pale yellow masses, which on closer examination are seen to consist of loosely adherent concentric laminae of the same opaque pale yellow material. Along the peripheral portion of the tumor, beneath the thinned out portion of the capsule, cystic spaces of varying size are seen, partly filled with a pale yellow pasty material of gritty consistence, calcareous in nature. Calcification has supervened on degenerative changes in the bursa. (Figs. 2 and 3).

The microscopic appearances were similar to those in the next case, which is described in detail below.

Due to reasons beyond our control, the second tumor on the right side was not removed, and the patient was discharged from the hospital on 28-4-45, and subsequent attempts to trace his whereabouts have failed.

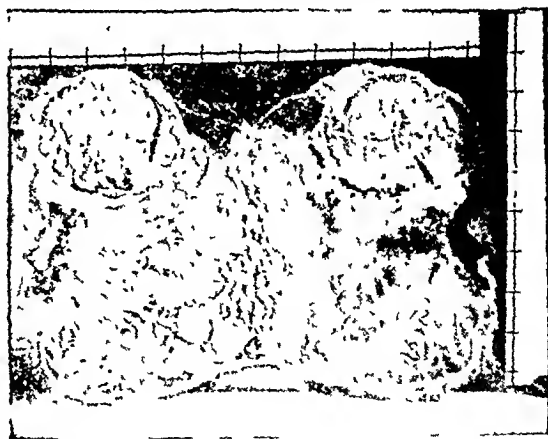


Fig. 3.

Case 1. Same as 2, showing the cut surface.

#### Case 2.

M., male, aged 15 years, farmer by profession, was admitted for a swelling on the lateral aspect of the right thigh, of two months duration on 2-11-45.

Six months ago, while running in a ploughed field, he slipped and fell on his right side. He got up immediately and resumed work without any pain or discomfort.

Four months later, he noticed a swelling on the lateral aspect of the upper part of the right thigh,

which was gradually increasing in size. With increase in size pain appeared, more after walking long distances or working in the fields. Soon after he noticed the swelling, he had an attack of fever lasting two days.

The patient was a moderately well built person. There was a hemispherical swelling in the right trochanteric area, 20 by 20 by 6 cms., woody hard in consistence, with well defined borders except in the posterior and inferior regions. The swelling was not adherent to the skin, but when the femur was moved, the swelling appeared to move with it, but the tumor could also be moved independent of bone, and caused the suspicion of a pedicle. All the systems were normal. The r.b.c., w.b.c., tuberculin test, the sedimentation rate were all within normal limits. Blood calcium was 11 mgms. and blood phosphorous 2.1 mgms. %.

Roentgen examination showed a large shadow completely overlapping the upper end of the femur, and the bone underneath appeared normal. (Fig. 4).



Fig. 4.

Case 2. Roentgenogram showing calcified bursa.

Preoperative diagnosis was doubtful as in the last case, the very large size suggesting a calcifying chondroma, while the very short duration was in favour of a bursal affection. Operation was performed on 8-11-45 under open chloroform narcosis. The tumor was bound down and adherent to the gluteal muscles, which had to be cut in parts to free the tumor, but had no contact with the bone. The greater part of the tumor was cystic and contained a thick gritty material.

Convalescence was normal, and the patient was discharged from the hospital on 24-11-45.

#### Description of Specimen :—

The tumor is roughly kidney shaped. Lateral surface is convex and appears to be lobulated. Medial surface is slightly concave and smooth. It is well encapsulated, 15 by 11 by 6 cms. in size, and weighs 695 grammes. On section the capsule is thick and firmly adherent. Dense greyish fibrous tissue is seen along with numerous islands of varying size consisting of pale yellow homogeneous cheesy material. Several of these have coalesced to form large irregular pale yellow areas. The appearance is not unlike that seen on section of matted caseating lymph glands. The cheesy material is gritty. There appears to have been degeneration of portions of the tumor with subsequent calcification. (Figs. 5 and 6).

The microscopic appearance shows branching fibrous processes, the intervening spaces filled with dark blue masses. The fibrous processes consist of fully formed fibrous tissue, parts of which show hyaline changes. The centres of these contain a core of blood vessels in which red blood corpuscles can be seen. At the margin of some of the fibrous processes are seen fibroblasts, numerous macrophages and foreign body giant cells. Lymphocyte infiltration is also noticed. No definite epithelium is seen to line these fibrous processes. The border appears as a dark blue line made up of particles of the same colour. The intervening spaces between the fibrous processes are filled with dark irregular clumps. These are probably calcareous in nature. There has probably been a degeneration of the lining secreting cells of the bursa, with subsequent calcification, the calcareous particles exciting a macrophage and giant cell response. (Figs. 7 to 9).

#### TREATMENT

If the condition warrants on account of the size and mechanical disability, or due to pain, removal is obviously indicated. Removal gives permanent relief and is simple. Physiotherapeutic measures have been advocated, and may be tried in cases where consent for removal is not forthcoming.

#### SUMMARY

1. The anatomy of bursae round the great trochanter of the femur is described.
2. Two cases of calcification (one of them of unusual size) in the bursa near the great trochanter is described in detail.



Fig. 5.

Case 2. Showing surface of bursa after removal.



Fig. 8.

Microphotograph showing marginal deposit of calcium—(darker areas).

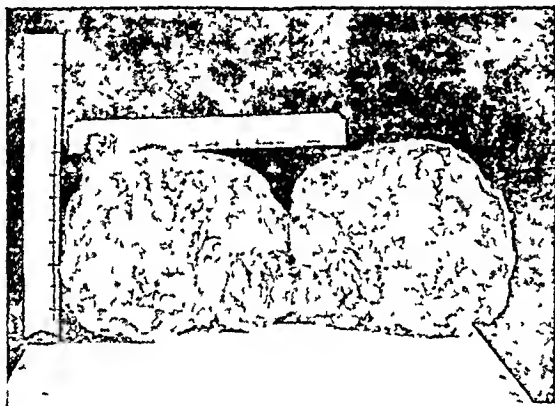


Fig. 6.

Case 2. Same as 5, showing the cut surface.



Fig. 7.

Microphotograph showing branching fibrous processes.



Fig. 9.

Microphotograph showing clumps of calcium between fibrous trabeculae.

3. It is suggested that

(a) for calcification, trauma and haemorrhage are not necessary precursors,

(b) calcification and 'local tuberculous diathesis' may be inter-related.

4. Treatment is by removal and gives permanent relief of symptoms.

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# EPITHELIOMA OF THE BUCCAL MUCOSA\*

by K. M. RAI.

In this discussion I propose to include carcinomas of the lip as well, as very often one leads to the other and their histological characteristics are also identical.

Cancer of the lip and cheek is a definite clinical entity. It accounts for about 10 per cent of all intra-oral neoplasms. It is a disease of the elderly and old patients and

cers. About 88% of all the cases occurred in the age group 30—60 years; the sex incidence in the above series is about 75 per cent in men and 25 per cent in women whereas in the Western countries the incidence is 85% and 15%. The majority of tumours are squamous-celled carcinomata, and the degree of differentiation shows variations similar to those in the tongue and

## DURATION

1. M.	2. M.	3. M.	4. M.	5. M.	6. M.	7. M.	8. M.	9. M.	10. M.	11. M.	12. M.	Over 1 year	No. Notes	Total
36	67	73	62	19	70	11	22	7	13	7	56	29	261	733
	14.2%	15.5%			14.8%									

Males	Females	Total	Higher Class Middle Class	Poor	Total
545	188	733	74	659	733
74.35%	25.65%		10.1%	89.9%	

## SITE

R. C.	L. C.	Cheek	Right Lower lip	L. L. L.	R. L. L.	L. U. L.	Lip.
261	352	643	23	60	3	4	90
40.6%	59.4%		25.6%	66.7%	3.3%	4.4%	
Total							733

## AGE GROUP

1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	Total
1	1	43	182	289	177		6	733
			24.8%	39.4%	24.15%			

## GLANDS

No palpable glands	Glands present not fixed	Glands fixed	Total
161	151	421	733
22%	20.5%	57.5%	

in my series of 733 cases a large percentage occurred in the fifth decade of life, on an average; about 10 years earlier than in the Westerners. This age incidence is in conformity with the occurrence of other can-

\*From the Barnard Institute of Radiology, Madras.

the rest of the mouth from the keratinizing to the anaplastic type. Some of these tumours originate from the mucous secreting glands of the cheek and these form the small minority of adenocarcinomata. Benign tumours are rare and are most commonly

met with in association with similar tumours of the salivary glands and belong to the group of mucous-and-salivary gland tumours.

Sarcoma sometimes occurs in the substance of the cheek and involves the buccal mucosa; generally it is of the small round-cell variety, extremely malignant, and gives rise to rapid visceral dissemination. It occurs in young patients and the sex incidence is said to be equal. The disease has been recorded in the literature on several occasions. In my own series there was only one case which occurred in a young girl of 8 years of age. It responded rapidly to irradiation treatment and so did the cervical glands. Within a few months wide spread metastases occurred.

The macroscopic types fall into the three common groups; papillary, ulcerative and nodular. Adenocarcinomata are nearly always of the nodular type. The lesions in the buccal mucosa seem to be closely related to precancerous conditions such as leukoplakia, and chronic irritation from sharp carious teeth, heat or chemicals such as tobacco and lime as in the betel-nut chewers of the west coast of Madras Presidency.

On examination of these cases the buccal mucosa is found to be redder than normal, slightly velvety in places, uneven, and sometimes rough; the smooth shiny appearance is lost, and the areas affected are dry.

Histological examination of small pieces removed from these patches of altered mucous membrane shows an increase in the thickness of the epithelium and marked downgrowth of epithelial columns, features similar to those found in leukoplakia elsewhere in the mouth. Leucoplakia of the thin mother-of-pearl type in patches or streaks is seen in the rest of the mouth. Eventually these develop into an epithelioma and when the lesion is fully developed it infiltrates the substance of the cheek and in advanced cases many of them perforate externally.

The lesion may begin anywhere in the buccal mucosa, either in the upper or lower

gingival sulcus and spread to the centre or may start in the lips and spread to the cheeks or vice versa; the commonest site, however, is the centre of the cheek at a level opposite the upper and lower molar teeth. The early symptoms caused by the lesion may be some discomfort, to which the patient with a precancerous mucous membrane is accustomed to and takes no notice. The commonest history one gets is that there was some tooth ache which was not taken notice of. When ulceration occurs the lesion becomes infected, and pain and some restriction in opening the mouth follow. The papillary type presents a typical appearance, the warty growth being as a rule dead white, in marked contrast to the remainder of the buccal mucous membrane. On bidigital examination the substance of the cheek is felt to be thicker and harder than on the opposite side. Invasion of bone more often of the lower jaw, is found in the extensive ulcerative type of lesion untreated or inadequately treated by minor surgical interference or in failures following radiation treatment. A peculiar feature in the incidence of this disease is that it predominantly occurs on the left side whether it be the cheek or the lip. On the cheek it is 60% on the left side. Do most people eat on the left? Another interesting feature is that the incidence in the middle and upper classes is comparatively very much less. In the above series it is 10% as against 90% in the poorer classes. I am convinced that social and economic conditions do play a great part in the incidence of this disease.

In my series of 733 cases, invasion of the cervical lymphatic glands occurred in 78% cases. Of these in only 20.5%, the glands were not fixed. The incidence of glandular involvement from the cheek is greater than in the case of the lip but smaller than in the case of the tongue.

The distribution of the metastases in the neck is somewhat different from that in the case of lesions of the tongue. The sub-maxillary and the upper deep cervical glands are more frequently affected in the case of cheek and the submental in the case

of the lips and this has a bearing on the extent and nature of treatment of the glandular area.

### DIAGNOSIS

Diagnosis of the neoplasms of the buccal mucosa is generally based on the clinical appearance of the lesion. If the neoplasm is of the papillary type the clinical differentiation between benign and malignant papillomata is sometimes difficult or impossible; in the ulcerative type the differential diagnosis between chronic, simple or specific lesions and a malignant ulcer is based on the hardness on palpation, the type of the edge and the appearance of the base of the ulcer. In the nodular variety differentiation from benign tumours is difficult. In all cases where there is a doubt it is essential that the patients should be submitted to a biopsy. In the presence of leucoplakia in certain number of cases repeated biopsies may be necessary and there should be no hesitation to do this as after all, this method of diagnosis is the least likely to waste time,—the time factor being the most important single factor in the prognosis of a malignant growth. At the same time the histological finding provides a very valuable guide to the differential diagnosis of the various types of tumours, and is a step in assessing the prognosis and the chances of glandular involvement.

### METHODS OF TREATMENT

Surgical excision as usually practised consists in the removal of the tumour through the mouth in early cases or together with the skin and the whole thickness of the cheek in more advanced cases followed by some form of plastic operation. The results of surgical treatment are said to be comparatively good if the excision is wide. Mutilation is greater than from irradiation and functional disability is at times very marked. As the tumours at this site are squamous-celled carcinomata in the majority of cases and respond well to irradiation, in my opinion as also in the opinion of other Radiotherapists, the results of radiation

therapy justify its selection as the method of choice. Surgical excision of these lesions has been almost entirely given up in our hospital.

The methods of irradiation depend upon the size and depth of the lesion and can be subdivided into five main groups (1) Intra-oral surface irradiation by radium; (2) Interstitial irradiation by radium; (3) External surface irradiation either by X-rays or radium; (4) low voltage short distance X-radiation (-Chaoul) or (5) A combination of intra-oral and external irradiation.

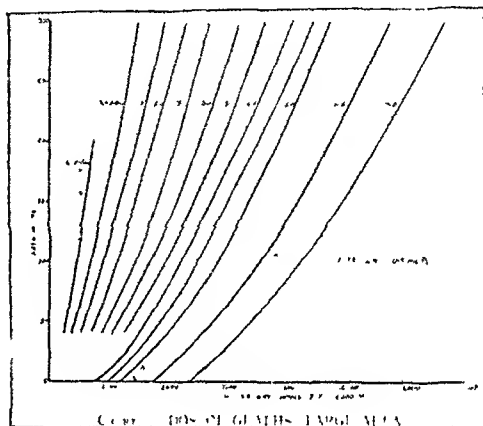
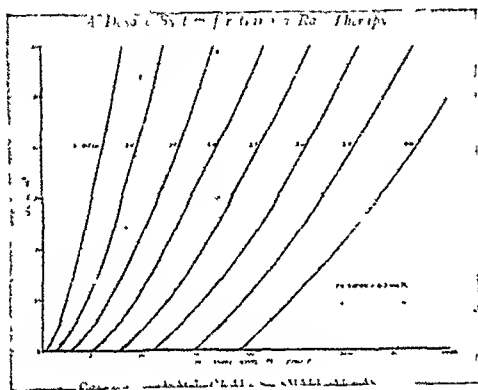
### TECHNIQUE OF RADIUM TREATMENT

Intra-oral surface radiation with radium—For a localised growth not invading the muscles or the gingival mucosa, surface irradiation from within the mouth is a simple method, it has the advantage that it requires no anaesthetic and no operative procedure. Preliminary oral toilet and extraction of teeth should be scrupulously carried out in every case. A week or 10 days spent in clearing oral sepsis is certain to pay a good dividend in the end. It should be clearly understood that sepsis and heavy irradiation never go well together. The condition of sepsis and oedema of the tissues bring on a state of anaerobiosis which is inimical to the success of irradiation. Even in the advanced cases where any form of therapy is of doubtful value steps taken to eradicate sepsis is of much palliative value. Therefore, these measures are a routine practice with me. A stent impression is then taken of the cheek to be treated, including the lesion, the palate, and alveolus of the upper and lower jaws. This shield fits in between the alveoli and the cheek, and its outer surface is in contact with the neoplasm. At a suitable depth usually 1 cm. from the outer surface of the denture the radium needles are embedded according to plan.

This apparatus provides surface irradiation at a distance of 1 c.m. from the surface of the lesion. If success from radium treat-

ment should be attained every meticulous care should be taken with regard to the correct planning of treatment and details of its execution. The least error in the execution of these details of technique is as disastrous here as in surgery in relation to the final results. As in surgery, so in radiotherapy the first chance is the best chance and if this is missed by an error in the tech-

being 12 to 14 hours daily. Most patients tolerate this fairly well, provided the whole treatment is finished in 8 to 10 days. Thereafter the treatment becomes more difficult as the reaction begins to start and the wearing of the temporary denture becomes uncomfortable. The greatest amount of radiation is no doubt received on the surface of the tumour and the least on the skin but the



Figs. 2 and 3.

Paterson and Parker's Dosage graphs for Surface Irradiation at different distances. The abscissae read the Milligramme-Hours per 1000r and the ordinates the area in sq. cms.

nique or dosage then nothing but calamity overtakes the patient. It has been conclusively proved beyond doubt that the rate of 5-year cure falls from 85% to 11% with regard to recurrence. Our technique for surface irradiation with radium is a system evolved out of the methods employed at the Royal Cancer Hospital, London and the Holt Radium Institute, Manchester. The technique adopted in treating a lesion is as follows. The lesion is first measured including a safe margin of apparently healthy area round the lesion. The appropriate quantity of radium to deliver the lethal tumour dose is then decided upon from the relevant charts. The next step is to determine the distribution of this selected quantity of radium according to certain physical principles so as to ensure a homogenous distribution of radiation throughout the tumour and its bed. After this is done, the irradiation is given intermittently, the average time

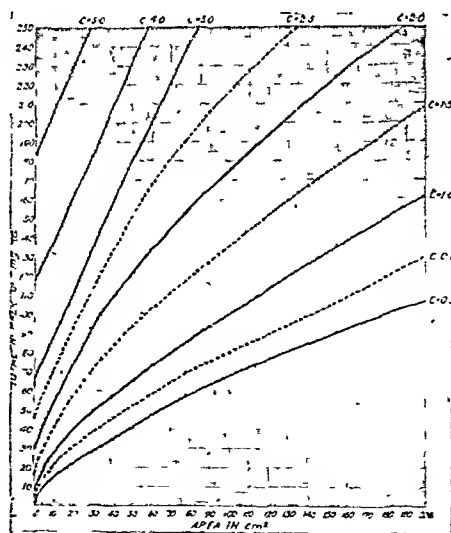


Fig. 4.

Mayenord's graph for determining the adequate quantity of radium to be used.

aim is to give about 6000r to the tumour. If this has not been possible, then supplementary radiation is given from outside either by means of radium in a sorbo-rubber pad or by deep X-ray therapy. The typical reaction that one obtains in such a case is a thin whitish membrane with red margins; this membrane becomes thicker and yellowish with fibrinogen, etc. and continues to be in colour in about a week due to the forma-

so for the next 8 or 10 days and then begins to get thinner and thinner until it finally disappears in about 4 to 6 weeks leaving a reddish, healthy area. Any attempt at removal of this membrane results in bleeding and the membrane again reforms quickly. Protection to the rest of the mouth from stray radiations is obtained by the incorporation of suitable thickness of lead foils on the oral side of the mould.

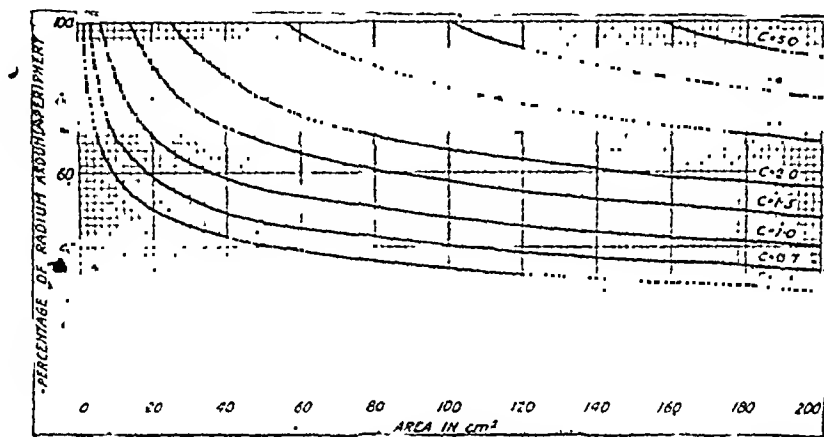


Fig. 5.

Dr. Mayenord's graph shows the quantity of radium to be distributed along the periphery.

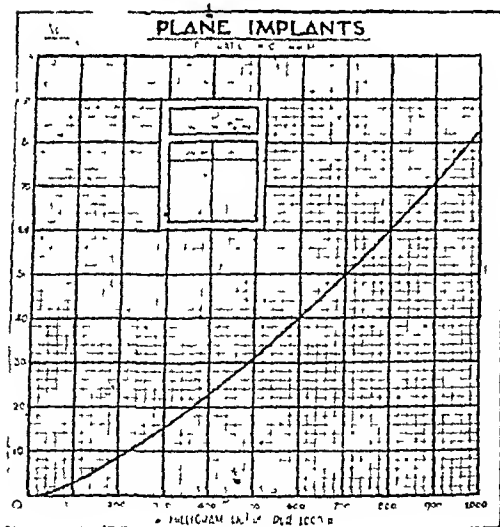


Fig. 6.

Paterson and Parker's graph for Plane Implant Dosage. The abscissae gives the Milligramme-Hours per 1000r and the ordinates the area in sq. cms.

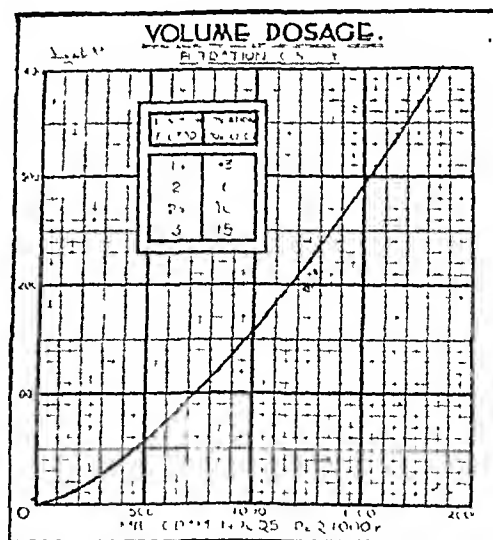


Fig. 7.

Paterson and Parker's graph for volume implant dosage. The abscissae gives the Milligramme-Hours per 1000r and the ordinates the volume in cubic cms.

### INTERSTITIAL IRRADIATION

This is no doubt the quickest method and a total dose of 6000 to 8000r can be given in a week with small quantities of radium such as 10 or 20 mgm. The lesion in the buccal mucosa is particularly suitable for this method, as in the majority of cases a one plane implantation is sufficient and the lesion can be very accurately treated. The needles are placed in a plane parallel and deep to the lesion according to plan, the area treated in all cases being larger than the actual tumour. The number of needles depends on the size of the tumour and is calculated with the aid of different charts.

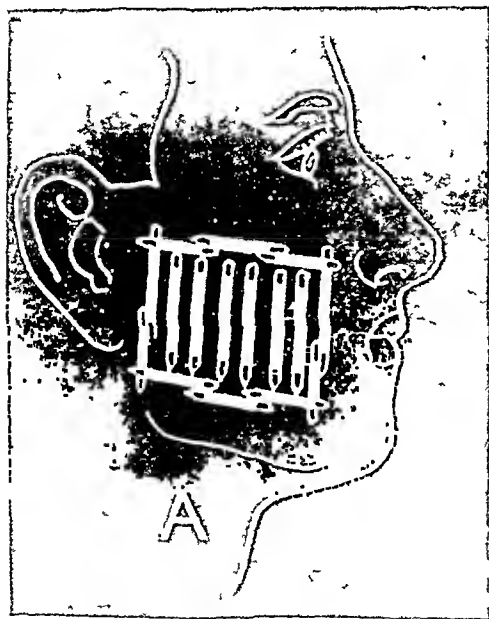


Fig. 8.

Example of a Plane implant in the cheek.  
(After Paterson and Parker)

If the needles are placed in pairs from opposite directions and tied they need not be sutured in and are easily kept in position for the necessary time; otherwise special care should be taken to anchor each needle separately; the total time of interstitial radiation varies from about 120 to 192 hours

on an average. In lesions involving the deeper aspects of the skin a combination of interstitial needling and an external surface irradiation is indicated.

The following case, more advanced than the type mentioned illustrates the result of this method:

Male aged 66 a University Professor was treated by me by needling, first from inside the mouth, then external irradiation with deep X-ray therapy. The lesion was an extensive and inoperable ulcer of the right cheek which had envolved the jaw, perforated through the skin, and formed numerous sinuses. Biopsy—squamous called carcinoma with hardly any keratinization. The dose as measured in the centre of the tumour by this combined method was in the neighbourhood of 7000r. The condition resolved satisfactorily leaving two sinuses and an osteomyelitis of the lower jaw. The patient also improved in general health, but died 18 months later. (Fig. 9.)

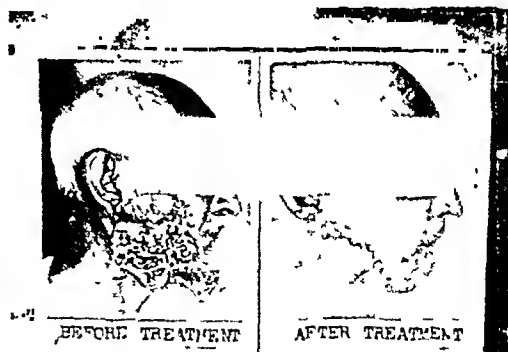


Fig. 9.

### EXTERNAL SURFACE IRRADIATION

External surface irradiation of lesions of the buccal mucosa can be employed as the sole method of treatment, but it is not a practical method, as the reaction of the skin limits its application except in the case of the lips. In combination with the interstitial method it is a useful additional treatment and should be carried out in cases where the skin is involved. It is a simple

method of irradiation, requiring about 30 to 40 mgms. of radium. A sorbo-rubber plaque of 2 c.m. thick is generally used as a support to which are attached the required number of needles of radium. The needles are arranged in squares or circles or some other geometrical figures to ensure homogenous distribution of radiation in the area under treatment. The area irradiated should exceed in all directions the extent of the lesion. As an alternative to the above, I invariably use deep X-ray therapy which is much simpler and easier to carry out.

No case of epithelioma of the cheek can however be treated effectively with either deep X-ray therapy or teleradium alone without at the same time producing a membranous reaction on the side of the tongue, the gums and the palate. The additional discomfort is sometimes considerable; the extent of the reaction and the length of time required for the treatment are drawbacks which should be taken into consideration.

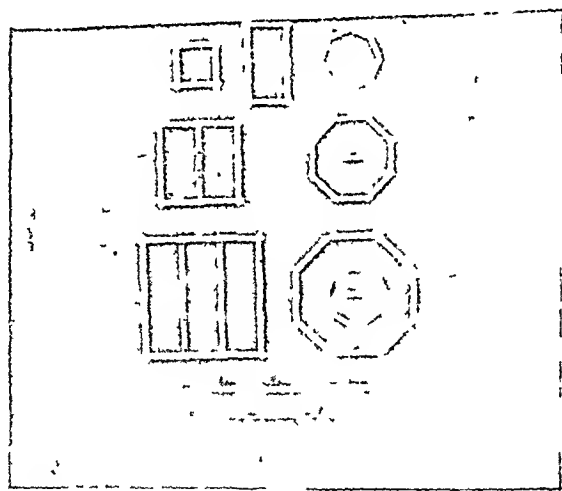


Fig. 10.

Diagrams of typical geometrical distribution of needles for homogeneity of dosage.

(After Paterson and Parker)

### LOW VOLTAGE X-RADIATION

In early lesions the low voltage short distance X-radiation otherwise known as Chaoul therapy is the ideal method which requires no hospitalization, is rapid and accurate and the results are as good as any

and in properly selected cases has many advantages over any of the methods described hitherto. There are certain well-defined principles which should be scrupulously observed in this method, failing which the results may be disastrous. That is why one hears of conflicting reports regarding the efficacy or usefulness of this method of treatment. If all the principles of the technique, its limitations, etc. are understood it is as efficacious as radium in its results, far more accurate, more easily carried out, less troublesome for the patient, takes only a few minutes every day and last but not the least important—the patient does not require hospitalization; where necessary this can be combined with deep X-ray therapy to get the required dose and its homogenous distribution :

Illustrative cases—

(a) only with Chaoul.

(b) Chaoul and deep X-ray combined.

Mr. B. aged 61 years reported for treatment on 2-10-1940 with a history of two

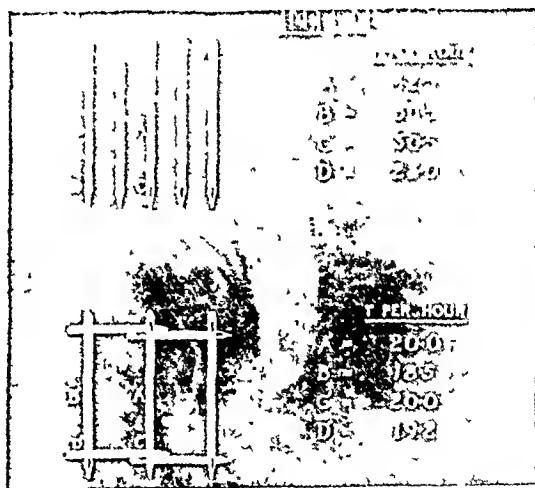


Fig. 11.

This illustrates importance of proper geometrical distribution. The effect of variation in intensity at 1 cm. due to different arrangements is shown (After Paterson and Parker)

months. He had an epithelioma of the left cheek and gums of the lower jaw extending as far as the canine tooth; no evidence of secondary glands.

A dose of 6000r was given to the whole lesion in 15 sittings through 5 fields ending on 19-10-1940. The lesion healed well. The patient again reported for examination on 5-8-1941 and on examination it was found that the original ulcer was well healed leaving a soft supple scar. But posterior to this scar, there was a small ulcer about the size of a two anna silver coin with hard indurated base covered with a greyish white slough. Biopsy proved it to be a recurrence. This was again treated with chaoul therapy and the patient is alive and well upto date with no secondary glands.

Mrs. K. P. aged 55 years, reported on 13-12-1943 and treated by me first from inside the mouth with Chaoul contact X-ray therapy and then by external irradiation with deep X-ray therapy at 150 kv. to obtain the required homogenous radiation throughout the tumour area.

The lesion was a hard raised plaque 3.5 c.m. in diameter over the left cheek, situated opposite the 2nd premolar and first 2 molars infiltrating the deeper tissues but not involving the skin. No palpable glands in the neck or submaxillary region, were present.

Duration — 6 weeks.

After preliminary attention to the dental condition, a total of 6000r was given to the lesion in 16 sittings over a period of three weeks. This was followed by external X-ray therapy at 150 kv. at 200r per sitting and a total 2000r was given over 11 days.

The patient is alive and well to date. No secondary glands have appeared so far.

Mr. C-J-W., aged 80 years. Referred on 28-8-1939 and treated. This patient had an epithelioma of the right lower lip outer third—involving the whole thickness of the lip—of eight months' duration. No palpable glands either in the submental or sub-maxillary region. The thickness of the lesion was 2 c.m. The condition was treated with Chaoul therapy by two fields sandwiching the area and a total dose of 6400r was given in 16 sittings over a period of 18 days.

The condition completely healed leaving a soft supple scar. The patient is alive and well with no metastases after 8 years. (Fig. 12.)

### MULTICENTRIC EPITHELIOMATA OF THE BUCCAL MUCOSA

The condition is sometimes met with and is either precancerous or definitely epitheliomatous. It is characterised by the superficial spread of the lesion over a wide area with little tendency to penetration into or involvement of the submucosal tissues. The main characteristic is its chronicity. A history of 18 months to 2 years is usual. Clinically it differs from leucoplakia. As a rule the white patches are absent. It occurs most frequently at the junction of the hard and soft palate, spreads to the uvula, the

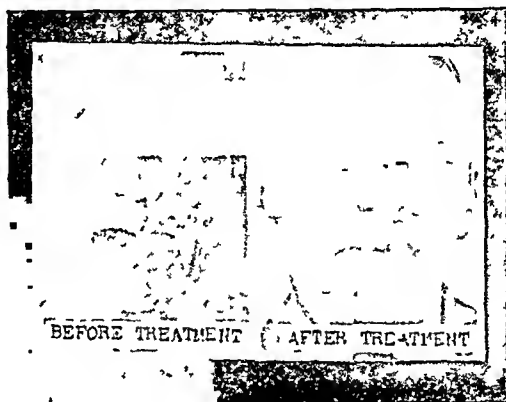


Fig 12

pillars of the fauces, the alveolar mucous membrane, and the sulci between the cheek and gum and even to the vermilion part of the lips.

The lesion is a superficial ulceration surrounded by an erythematous zone; small papillary masses are scattered at the edges of the lesion. The remainder of the mucous membrane is atrophic. The symptoms are those of chronic superficial ulcerations, discomfort, slight pain, loss of taste, a sensation of pricking and burning, and dryness of the mouth. Malignant changes take place in one part, the remainder not undergoing such a change for sometime but as the condition is precancerous, any area may



become malignant, and give rise to multicentric lesions.

Secondary deposits occur in the glandular areas in spite of the apparently superficial character of the growth. The glandular involvement is localised and the prognosis is moderately good.

The superficial nature of the lesion and the marked degree of radiosensitivity make it a suitable type for radiation treatment; and perfect healing of the superficial ulcers with arrest of the hyperplasia can easily be obtained. I prefer Chaoul's therapy to radium for the primary lesion.

### ILLUSTRATIVE CASE

Mr. U. A. aged 32 years reported on 18-5-1939 with an epithelioma of the left cheek opposite the molars of 3 months' duration and a wide distribution of leukoplakic patches all over the buccal mucosa. This malignant portion of the lesion alone was treated with Chaoul therapy with complete healing. A complete dental extraction was done after this treatment and supplemented by suitable medical measures. The patient is alive and well after over 8 years.

### METASTASIS IN CERVICAL LYMPHATIC GLANDS

The field of lymphatic spread from the mouth must be considered as extending from the highest to the lowermost levels of the neck. Obliteration of the normal lymphatic vessels by active malignant disease, fibrosis or surgical removal diverts the lymphatic stream into new channels, so that further extension by direct spread or embolism takes place in anomalous site. The rapidity of dissemination and the susceptibility of the glands to metastasis varies in direct proportion to the degree of anaplasia of the growth.

The appearance of palpable glands in the neck may be early or late. The late development of secondary deposits in the cervical glands long after the disappearance of the primary growth in the mouth show that there is a period of latency which may last

many months to years during which clinical methods of examination cannot reveal the presence of malignant cervical deposits. The marked failures of incomplete operations for the removal of the cervical glands, the hopelessness of cases where the glands are inoperable, and the death of patients from cervical deposits although the primary lesion remains healed are convincing proofs of the importance of early and adequate treatment. The problem presented by all these cases is to determine the best way of dealing with these.

An answer to this raises several problems:

1. Does absence of palpable glands offer absolute indication of freedom from disease?
2. Are all enlarged glands necessarily malignant?
3. What is the role of surgery and irradiation individually and in combination in the treatment of
  - (a) cases where regional glands are not palpable,
  - (b) cases where they are palpable but are operable,
  - (c) cases where they are palpable but are inoperable.

Absence of palpable glands does not necessarily mean that metastasis has not occurred. In a number of cases the primary lesion was completely cured and remained cured; no palpable glands were detected in the neck for several months to years after the disappearance of the primary and then they developed rapidly.

It does not always mean that an enlarged gland is due to malignant infiltration. Some of them are enlarged as a reaction to septic absorption from the oral cavity and this has been repeatedly confirmed histologically.

The factors that influence the choice of the line of treatment,—surgery or irradiation or a combination of these two—are

- A. Site of the primary lesion, its extent and the length of the history.

B. Histological features of the primary growth.

C. The clinical condition of the lymphatic glands.

And to these should be added the condition of the patient—his general health and age.

#### A. SITE

*The lip.*—In carcinoma of the lip the development of secondary deposits in the cervical lymphatic glands is exceptional unless it is advanced. Most authors report that on an average 80% of cases do not develop metastases. The earlier the lesion the better the prognosis; in advanced cases the glands are either affected when the patient first seeks treatment or develop subsequently. In the case of the lip I am of the opinion that in the absence of enlargement no treatment of the glands either by surgery or radiation is indicated. If the primary lesion responds well to the treatment and disappears completely, the neck can be safely left untreated provided adequate periodical supervision is carried out. Should the glands enlarge subsequently, immediate treatment is indicated.

*The buccal mucosa.*—The incidence of glandular involvement from a neoplasm of the buccal mucous membrane is greater than in the case of the lip; most statistical tables give the incidence as 50 per cent of the total early cases. If the lesion is left untreated for a prolonged period the glands will become affected in most if not all cases but the development of metastasis is never as widespread as in the case of the floor of the mouth or the tongue or the palate. The lymphatic drainage is more limited and at first restricted to the submental and submaxillary glands, and in some cases to the pre-auricular gland, then to the upper deep cervical glands. An operation limited to these areas may be permissible, in contradistinction to the full block dissection but operation and irradiation both pre- and post-operative, should be the method of choice in these cases as they are more certain of positive results. Irradiation alone is

not the method of choice in these cases and should be used only if operation is contra-indicated.

#### B. HISTOLOGICAL VARIETY OF THE PRIMARY GROWTH

The natural history and the course of the disease depend largely on the histological variety, of the primary growth. The prognosis as regards liability to lymphatic metastasis and hence the ultimate prognosis depends eventually on the structure of the tumour. In the choice of treatment of the lymphatic field the histological variety should therefore influence both the selection of treatment and the prognosis. It is recognised that 'the most malignant, anaplastic undifferentiated growths are prone to early lymphatic dissemination, and as these lesions are in the majority of cases radio-sensitive the first step in the treatment should be radio-therapeutic measures—X-rays or Radium. If irradiation causes complete disappearance of the enlarged glands no further treatment is indicated. Repetition of the treatment remains a separate problem for each individual case. If irradiation does not cause complete regression of the glands, operation must be undertaken without delay.

Post-operative irradiation is indicated if the disease has not been adequately dealt with by the operation as also in anaplastic lesions. In the case of the transitional type or the keratinizing variety, operative removal would give better results in the majority of cases and should be the method of choice, provided a very complete and wide dissection can be carried out.

Irradiation is the method of choice in the undifferentiated type of carcinoma; and is the only justifiable method in sarcoma. Surgery will always be safer if pre-operative irradiation in small doses (not exceeding 2000r to the skin) is given. The results of surgical treatment can be improved by pre and post-operative irradiation in most cases. The results of irradiation can be sometimes improved by surgical excision in selected cases of anaplastic but radio-resistant neoplasms.

### C. THE STATE OF THE GLANDS

Difficulties occur in the selection of treatment in various stages of the disease. All cases of cancer of the mouth fall into one of the following three groups (1) where no glands are palpable on clinical examination (2) where enlarged but movable glands are present (3) where the glands are fixed, on the borderline of operability or frankly inoperable.

1. *Where the glands are not palpable.*—The most difficult problem is in the case of a patient with no palpable glands in the neck. Opinions differ very widely as to the best course to be adopted. The possibilities open to the surgeon are as follows: (a) No active treatment—the patient to be kept under continuous observation and the development of glands awaited before any treatment is given. (b) Irradiation by X-rays or Radium as a prophylactic measure. (c) A block dissection to be carried out in every case. The problem is of such great practical importance that a detailed consideration of each of these possibilities is indicated.

(a) A policy of 'watch' without active treatment—This course is advised by some authorities particularly the Manchester school and I fully agree with this view if the patient will intelligently co-operate with you. If this is doubtful and the general health of the patient warrants and there is a reasonable chance of a permanent cure of the primary lesion—then operate. But it is difficult to persuade a majority of such patients. Therefore we have been sometimes able to reverse the sequence of treatments, i.e. first do a block dissection and then treat the primary. How far this is a justifiable, I am not in a position to state.

(b) The so-called 'prophylactic irradiation'—this method of treatment has been tried very widely. I have given this method a good trial and have discarded this method as disappointing in results and unsound and unscientific. It should be accepted that such an irradiation presumes the presence of malignant infiltration of the cervical glands, so that nothing short of a full lethal dose is

likely to arrest the disease. If this presumption is correct, although a clinical examination does not reveal any abnormality in the neck, the word prophylactic is a misnomer, as the irradiation has for its object, not the prevention of metastasis, but the destruction of already existing malignant cells, however small in number or however silent clinically. A review of all the available literature leads to the following conclusions. So-called prophylactic irradiation of an apparently normal neck is not justifiable; it does not prevent the ultimate development of secondary deposits in the cervical glands; it is at times distinctly harmful as it renders subsequent treatment by radiation when metastases occur and when radiation is urgently needed, more difficult and less effective and sometimes impossible owing to the changes in the skin, subcutaneous tissues, and vessels. It also considerably increases the difficulties and risks of any subsequent surgical operation on the cervical glands due to the above changes.

(c) Prophylactic block dissection—This is not done in our hospital and I am not in favour of it either for reasons already given.

2. *Where the glands are palpable but movable.*—In this group treatment is obviously essential, and the selection of treatment lies between surgical excision and radiological treatment. Having tried radiation as the sole method of treatment, I have come to the conclusion that today wide surgical excision gives better results. It matters little how the radiological treatment is given; if safety from recurrence is the first consideration surgical excision offers more than any form of irradiation.

But it should be clearly understood that telerradium, X-radiation, or interstitial radium can arrest the disease completely in a certain number of cases, but the results of the treatment cannot be forecast. Surgical excision in operable cases gives an assurance that the whole lymphatic area has been removed but irradiation gives no such assurance. As the patient's life depends upon the result of the first treatment and if a case is suitable for radical surgery then

this should be made clear to the patient, and radiation should not be offered as "equally good."

Although surgery is unquestionably the best form of therapy it is not applicable to all cases, and success or failure depends upon careful selection of cases and faultless surgical technique. Knowledge of the disease, sound judgment in estimating the prognosis of the primary growth, clinical acumen in the correct interpretation of the extent and operability of the glands in the neck, are essential in the selection of cases. The following conditions should be satisfied in every case:

(a) The primary growth must be healed, and there must be a reasonable prospect of permanent cure.

(b) The histological picture of the primary must be of the type of Broder's group I or II.

(c) The glands, although palpable and clinically malignant should be mobile or only slightly adherent.

(d) The general health of the patient should not preclude a major operation.

If the above conditions prevail a block dissection should be carried out. It is perhaps not understood by a fair number of radiotherapists or surgeons what is meant by a block dissection. Judging from the limited skin incision in several of the cases labelled as 'block dissection' no such operation could have been carried out. The principles of the operation are the wide excision of the deep cervical fascia from the level of the jaw and styloid process to the level of the clavicle over an area covering the anterior and posterior triangles of the neck; with the fasciae are removed the fat and the whole of the glandular chain and this cannot be done adequately without removal of the sternomastoid muscle and

The value of pre- and post-operative irradiation of the neck has been much debated. My opinion is that pre-operative radiation renders the operation safer; the chances of disseminating the disease by the

surgical act are thereby lessened; the glands are diminished in size and the operation for their radical removal made more easy. Pre-operative radiation should not lead to a marked skin reaction; a total dose of 2000r to the skin is sufficient. It is a matter of no importance whether radium or X-rays are used. The treatment should in no way delay the operation; radiation of the neck should be followed immediately by operation without any intervening period. I generally give this dose in about 10 days and advise the operation immediately after. I have consistently followed this practice in cancers of the breast with very encouraging results.

A course of preoperative irradiation for cases on the borderline between operable and inoperable states is definitely indicated. In the majority of cases these inoperable lesions become operable after a certain period after the cessation of the irradiation therapy. The dose in such cases is higher, than in the previous instance. But I should add a word of caution, i.e. the operative procedure should be deferred till the tissue reaction completely passes off.

Post-operative irradiation is indicated only if the histological examination of the glands shows a secondary deposit. Post-operative irradiation by X-rays is as efficacious as by radium; it is preferable to radium as it is more simple. Post-operative irradiation should be given in about 3 to 4 weeks after operation, when the wound is soundly healed.

Radiation therapy in operable cases: In cases unsuitable for surgical excision, radiation should be given. If the glands are palpable, radium is said to give better results than X-rays, except in the anaplastic type, where X-rays are equally good but a combination of both radium and X-rays presents certain advantages, as this enables the radiotherapist to deliver a larger total dose than either method used to the exclusion of the other.

3. When the glands are fixed and inoperable.—This group of cases includes the advanced stages of the disease, varying from a small, hard, fixed mass of glands to diffuse

swelling of the side of the neck. Opinions are unanimous that attempts of surgical removal are contra-indicated. The chances of cure by surgery in this type of cases are remote, the danger of incomplete removal very real, and radiation therapy offers a means of palliation unparalleled by any other method of treatment.

The radiological treatment consists in a combination of X-rays and radium. Preliminary external radiation should precede the interstitial treatment which is a supplementary method of increasing the dose in the deeper parts of the mass. This treatment can reduce the tumour very appreciably, and sometimes leads to a total disappearance of the neoplasm.

## CONCLUSIONS

1. The varieties of carcinomata of the Buccal mucosa their diagnosis and treatment are discussed.

2. The techniques in radiation therapy have been discussed.

3. The relative positions of surgery and radiation therapy have been discussed.

4. In conclusion it is stressed that there should be a wholehearted understanding and cooperation between the surgeon and radiotherapist to attain the maximum benefit out of these different procedures if results have to be improved.

## EARLY AMBULATION IN SURGERY\*

by R. KALAMEGHAM and T. V. SUNDARAM, Trichinopoly.

In discussing early ambulation, Steinhart says "with surgical efficiency at its level we should not be satisfied with merely recovery from a surgical operation, but we should know, as Matas once stated how the patient has recovered, to what extent she has been restored to her anatomical and functional integrity and to what extent she has been cured and made fit to return to her normal life and occupation".

In this paper we have tried to put forth some of the ideas on post operative ambulation as practised to-day. The place of physical medicine in surgery has been amply demonstrated by the recent World-War, while this aspect is scarcely known in civilian Hospitals. The integration of the principles of physical medicine in surgery is a new development which has had rather very slow and tardy recognition when recent advances and trends are reviewed.

Enforced bed rest is a violation of the cardinal principles of physiology. Surgeons were hesitant to ambulate their patients inspite of conclusive proofs of its efficacy. This regimen is in wide practice only since 1941.

Surgery is advancing along lines of sound physiological principles. Even as early as 1861 James Hilton in his Hunterian Oration struck a note on physiological and mechanical bed rest in surgery and remarked that surgeons should always remember that Nature always tries to heal the injuries subjected to her tissues.

Recent advances in surgery are along lines to restore early physiology of tissues and not, as of old, in eradication of the pathology only, without any idea of restoring the physiological functions. Early

ambulation helps to an early restoration of the same.

The regimen of speedy rehabilitation is but a variant of early ambulation after surgery which restores the patient to early function and reversal to a state of normal physiological state.

Post-operative ambulation is defined as early rising and walking. Even after its wide practice since 1941, it is a much controversial aspect of surgery but the consensus of opinion is culminating into unchallenged acceptance of this method. Comparative analytical study of bed-resting and ambulant series of patients under controlled circumstances has proved the superiority of this practice.

Ries in 1899 was the first to report early post operative rising. He noticed that his gynaecological patients who rose earlier were strong and had few complications. He was not impressive in America then; but had adherents in the Continent since 1909. In 1941 Daniel L. Lithauser revived American interest by his report on 436 cases treated by this method. He roused enthusiasm among surgeons widely.

The practice had its inception on observations among children and individuals who violated routine bed-resting and insisted on visits to bathroom. Absence of complications in them observed by house staff and nurses provided as it is called "A Seven Day wonder".

We see children seldom keeping to bed after surgery. They toss in bed, strain and cry to the annoyance of the popular bed-rest-minded surgeon and staff. To one's great surprise, wound anomalies due to activity is seldom seen among this age group. The impressions from such post-operative activity seldom suggested the possibility of early post-operative ambulation without from the dreaded hazards.

\*A paper read by the latter at the Second Provincial Conference of the Indian Medical Association held at Coimbatore on 18-10-1947.

Here we may mention a very rare episode of an accidental self-imposed post-operative activity of one of our patients in 1944.

A 35 year old well built individual was operated on for an inguinal hernia under spinal. On the 2nd day he got maniacal unexpectedly and got out of bed and walked all over the place in a state of marked activity. He ambulated himself much to the anxiety and annoyance of all of us. We expected wound disruption and a certain immediate recurrence. It was amazing to note that he healed without any hazard inspite of the fact that he was sent home on the 3rd day due to this mental state. He was said to be fairly active all the days at home till sutures were removed and inspite of all unwarranted ambulation, then never known to us, he healed. He has been coming to us for review and to date he has no recurrence.

In experimental animals, they noticed that strong and sound healing occurred among those that were allowed activity as against those that were kept in enforced rest.

Apprehension of wound disruption and infection appears to be entirely unfounded as these were absent even among those rugged individuals who had got out of bed themselves without any planned guidance under supervision.

The surgical patient requires ambulation very early in the post operative period. Early rising is very essential for restoration of physiology. The time honoured enforced bed rest predisposes to complications to pulmonary, vascular and gastro intestinal systems among several others.

In 1913 Eugene Pool published a report entitled "Systematic Exercises" in post-operative treatment." He elaborated a definite set of exercises for the bed resting patient designed primarily to prevent pooling of venous blood and thus avoid any vascular accidents like phlebothrombosis, embolism, etc. Activity was observed to produce a lot of well being without any low

state of general condition or wasting of muscles. The patients felt fine with a full function of body and mind. Eugene's exercise in the bed was but a fore-runner of modern ambulatory management.

The proponents of early rising, quote the following phenomena.

1. Lowering of all pulmonary complications.
2. Stimulation of circulation without stagnation, due to movement, contributing to absence of vascular stasis.
3. Stimulation of gastro intestinal system with the consequent absence of nausea, vomiting, distension and ileus.
4. General and over-all physiological effect on body and mind—a healthy somato-psychic effect.
5. Speedy convalescence as a result of former.

After operation, due to pain in the incision the breathing is much slower with a marked decrease in the excursion of diaphragm. This facilitates pooling of secretions in the trachro-bronchial tree encouraged by a general low cough reflex present in recumbency. In addition, there is often excessive mucus and broncho-constriction especially after inhalation anaesthesia. All these factors precipitate pulmonary complications. A sitting posture stimulates cough reflex with easy expectoration of secretion.

Lithauser has estimated that the vital capacity of lungs returns to normal in from 2 to 7 days in the early ambulation patients. In the bed-resting group it is 7 to 14 days. In his study of 900 cases, he records an incidence of pulmonary complications in only two. It is indeed remarkable.

According to Newberger, Joseph and Boldt, early ambulation prevents abdominal complications like ileus, nausea and vomiting as mentioned previously. Absence of these spare the wound of all stress and

strains that interfere with sound wound healing. Bowel function is restored early and this stimulates the appetite.

Most of our type of patients find it very uncomfortable to use an urine glass or bed-pan. They are new to these and hence often fail to void urine or motion. If they are allowed to sit up or even squat, which activities they do gently, though with some apprehensions, they succeed. Catheterisation is seldom necessary and this means less strain to the staff and above all the prevention of the hazards of catheterisation to the genito-urinary tract. There is a slowing of circulation in the bed-resting patient with chances for thrombosis. The working of muscles stimulates circulation with remote chances for vascular accidents incidental to dorsal recumbency. In a shocked patient the often common after extensive procedures on chest or abdomen with haemoconcentration, all contributing to a vascular catastrophe. Such patients should be ambulated gradually as soon as they tide over the shock emergency. If they are not fit for ambulation bed exercises should be instituted.

A new York Hospital bulletin says that as many people die of pulmonary embolism as of cancer of stomach and bacterial endocarditis.

Smith and Allen say that early exercise prevents venous pooling. Frykolm remarks that venous thrombosis is common in plantar veins, veins of calf muscles, branches of deep femoral and pelvic visceral veins. He believes that blood vessels collapse in bed resting and shock with intimal contact which favours intravascular clotting in the presence of haemoconcentration, increased viscosity, and slow circulation.

A short account of statistical and comparative reports of early ambulated cases from various authors is worth mentioning.

One of the very famous proponents and authors of this Technique is Daniel L. Lithauser. He revolutionised the conception in the care of the post-operative patient. But for his pioneer work in this

branch of surgery the time-honoured conservative, unphysiological routine of bed-resting will be in vogue everywhere with all its attendant morbidity and mortality after major surgery.

In Lithauser's study of 900 major abdominal cases, the average discharge rate was 4 days. In an average of 2—5 days he has discharged appendix cases.

Rickles sends most of his cases home on the 3rd post operative day.

In Peter Bent Brigham Hospital in North America they studied a series of ambulant cases in as similar circumstances as possible enabling a scientific appraisal of end results. They practised early rising in 238 cases with 443 cases in dorsal recumbency. The operations were major ones on small and large bowel per lower abdominal incisions. Biliary, gastric and spleen surgery were done per upper abdominal incisions. They used interrupted cotton for all layers except for peritoneum which was closed by chromic catgut.

In the ambulated the results observed were as follows:—

1. Early regaining of strength.
2. No loss of strength.
3. Patients are active in bed with seemingly no discomfort in wound.
4. They were observed to get out of bed without assistance.
5. Very little nursing-care was needed.

64% of the early risers were discharged on the 13th post-operative day while only 26% of the control group could be discharged by that time.

They classified early risers into 1st day and 2nd day risers.

The following percentage of complications were observed in 1st day risers.

Pulmonary	4.9%
Wound disruption	1.1%



Wound infection	2.7%
Phlebitis	3.2%
Atelectasis	4.3%

## 2nd day risers.

Pulmonary	7.5%
Wound disruption	1.8%
Wound Infection	Nil
Phlebitis	1.8%
Atelectasis	5.7%

## In non-early risers of 443 patients.

Pulmonary	7.9%
Wound disruption	2.8%
Wound Infection	5.7%
Phlebitis	1.8%
Atelectasis	6.3%

In this study there is a higher incidence of phlebitis in very early risers. It is not so in many other's experiences. They conclude that early rising alone does not abolish phlebitis.

Steinhart's major gynaecological cases require 8.72 hospital days in early ambulated as against 13.94 days of late cases.

Cutter in 1941 remarked after a statistical study that 4.5% of all surgical patients develop pulmonary complications while some others believe that 10 to 20% of such patients develop pulmonary hazards.

With recent advances in the dictates of surgical principles and technique, with a focussing of attention on creation of "Good Risk" patients, with newer pre-operative care, undue apprehension of harmful effects of ambulation should disappear.

Hypoproteinaemia should be completely excluded in these cases. This state of blood chemistry favours wound disruption and delay in healing. The following abnormality exists in protein poor patients.

1. There is an aberrant function of the stoma after gastro enterostomy.
2. The Liver of these patients tolerate anaesthesia very badly.
3. The gastric function and motility are enormously upset.

The nitrogenous breakdown and catabolism after operations warrants the exis-

tence of the proper protein status of blood. Early ambulation for obvious reasons should not be thought of in hypoprotienae-mic patients.

A state of positive nitrogen tissue-blood balance exists if 0.30 gram of Nitrogenous material is given per Kg. of body weight per day with not less than 30 calories of carbohydrate supply per Kg. per day. The appreciation of physiology of dehydration, electrolyte imbalance, and hypoprotien-inaemia enables the correct institution of tion better than excess of salt or water.

Avitamoiosis especially of Ascorbic acid delays wound healing.

A careful selection of non-absorbable suture material and strain free transverse incisions are necessary in these cases. Lithauer uses transverse incisions and non-absorbable suture. He has been using steel wire sutures too. Homer L. Skinner prefers thin silk sutures after a study of 1126 cases of hernia.

The current trend of incisions is in favour of transverse ones in which plane stress is very negligible during ambulatory activity.

With these incisions post-operative comfort of ambulant patients is very great. Activities like getting up, retching, cough and movement, instead of tearing apart wound edges actually bring them in close alignment. Hence the value of these incisions in ambulant patients as defined by the proponents of this technique. The sound surgical work ensuring perfect haemostasis, least massing of tissue in ligature and perfect closure of wound in anatomical layers in "Good risk" patients will have negligible complications in this method of recent revolutionary post-operative management. Type of, suture employed should be of the non-absorbable variety though it is not a main consideration according to Skinner.

Peritonitis, haemorrhage, shock, anaemia and heart failure are some of the major contra-indications to this procedure.

A modern surgeon has at his command a wide armamentarium in amino-acids,

plasma, chemotherapeutics and antibiotics with which to manage his cases, that there should be very little challenge for this recent advance in post-surgical care. If a patient is got out of bed after the 1st 24 to 36 hours it is not early ambulation at all. Ambulation should be started within 1st 24 hours. It is said that 50% of complications start in the 1st 24 hours after surgery. By the end of 48 hours it increases to 75% and by the end of 4 days it increases to 90%.

In this paper we are not giving an account of any voluminous experience in post-operative ambulation. In limitations of private work we could try this method in a short series of 40 cases. A review of our experience does not leave anything to regret.

Our 38 cases constitute the following operations :

Total Hysterectomy	1
Appendicectomy	4
Laparotomy	6
Cong. Ing. Hernia child group	4
Inguinal Hernia adults and aged inclusive	25

Constant impact of knowledge through literature roused our enthusiasm on this subject. We incorporated this method of care in 1945 in our post operative treatment of cases of hernia to start with. We never had any occasion to compel our patients flatly to get up. A laborious counsel to the patients on the simplicity of the procedure and its advantages induced a confidence among them though they were hesitant and apprehensive of things rupturing inside. Some times we had occasion to make new comers see the already operated patients moving about. This enormously improved the morale of the prospective patient.

We had to do a lot of talking in a leisurely and laborious method before we could get most of the patients even to turn to the side. Some would tell us that they may be allowed to get up on the 2nd or 3rd day.

We were so painstaking that we could convince every one of them, even an aged woman of 60 from the village, about the efficiency of this, that, we had no unsurmountable difficulty of rousing them to ambulatory activity, according to programme. A young man from Simla wrote to us in so much praise of our method that we felt very elated. The Simla man had a previous hernia operated elsewhere in bed-rest for 3 weeks and hence he could assess the value of his previous and recent experience of hernia surgery.

Our hernia cases had a pre-operative look up of motions, urine and blood counts though we were ambitious to estimate their blood proteins as well. The latter could not be done for want of facilities. In our series we would make our laparotomy cases "Good Risk" ones, but the gastric perforations were emergencies.

I am only anxious to review our hernia cases in this paper.

We make a 4" to 5" transverse crease incision with the lateral 2" somewhat curved upward and outwards. We invariably employ spinal. In our series of 25 adult hernioplasty 20 had spinal and 5 had chloroform ether mixture. Children had pure ether. We use 60 cotton for ligature of blood layers. Thin silk is used for darning. We of Willy's Andrew's technique and leave intradermal cotton. Sulphanilamide powder is insufflated in the various anatomical planes.

The closed wound is covered with spirit-soaked gauze and strapped by adhesive plaster tightly. We don't use any bandage.

For ambulation we follow Lithauser's Technique in spirit though not to the very letter. It is done thus.

On the night of operation, the resident compounder helps the patient to sit if the patient so desires, to pass urine. Otherwise they are left alone. In our series, 15 could pass urine in recumbancy 2 required catheterisation and 8 were helped either to sit or turn to comfort. 2 had post-spinal headache requiring pethidine and I. V.

glucose. Post-operative discomfort is a personal factor. The villager required no sedative but the highly-strung patients required bromide. The next morning at about 10 A.M. i.e., after about 20 to 24 hours, we start the routine getting up.

The patient is asked to turn to the side of the incision and flex his knees and hip and raise himself by exercising of the normal flank muscles. He puts the feet on bedside stool and stands. As he stands, he is asked to take a few deep breaths, and cough voluntarily. While standing many shake on their limbs due to fear apprehension and pain which they do have to some extent. Very occasionally the spinal patients cough up some mucus. The general anaesthetised always expectorate some sticky fluid; some of them an amazing quantity. In a few moments the patient feels more comfortable and bold. He sits and lies down himself with some assistance and coaxing. After the initial getting up he feels pain less and less.

After another 4 hours, he gets up as described above and walks a few steps to a chair beside and sits there for a few minutes and goes back to bed. This he repeats in the evening and night.

Next day, i.e., 3rd post-operative day, he walks a distance that he feels confident of, as many times as possible. Majority of them seldom have the initiative to do the walking a number of times themselves. On the 4th day they report at the dressing room usually about 60 to 80 feet from their bed. Dressing trolley rarely goes to the bed for supervision and dressing of wound on the 4th post operative day. In our series, 3rd day dressing had to be done in bed in 5 of the patients who could not be persuaded to walk to the dressing room. For suture removal the patient again reports at the dressing room on the 9th post-operative day. By the 9th day the patient had been on so much of ambulation that he seldom shows any out-of-the routine feeling. He is used to walking and he does it. 90% of them required no enema and none of them had nausea, vomiting or

distention except 3 of the 5 anaesthetised, who had some nausea and a feeling which they explained as "liverish". All of them were allowed any food, of non-residue variety, if they had passed motion and flatus previously. Our single resident compounder and duty ward-boy had very little to do for these cases by way of nursing care. Our 4 appendicectomy patients had uneventful ambulation. All of them were educated and could follow our instructions without grave apprehension. They remarked that the ambulation was wonderful for body and mind. We were so proud to see our appendix cases walk to dressing room on the 4th day for scrutiny of wound. The patient-surgeon feeling was very cordial since the surgeon could see his patient moving about with an all pleasing attitude.

The children were allowed to be carried on shoulder of parents, all over the place and this saved the child so much of crying and the parents so much of a temper. The children were left to activity and parents were never bothered to put them to bed since we believed that the wound certainly would exercise a reflex inhibition of dangerously brisk activity.

In our series none of them had any episode of wound disruption or infection. 4 had tiny stitch abscesses with some suture material projecting into the wound. We pulled out the suture as far as it would come and cut the deep portion and allowed it to retract after a dab of mercurochrome. This usually was sufficient to cure the stitch sinus.

A 50 year old man who reported to us 2 months after discharge with a stitch abscess presented silk in the wound. We could pull out the whole length of silk that we had used for darning to our great annoyance. After a year he reported to us last month with a recurrent direct hernia.

We had no patient, developing pulmonary vascular or gastro Intestinal complications.

In our laparatomies we did the routine vertical incision much against our will

inspite of the fact that transverse incisions are better. The gastric perforation cases were not fit for ambulation since they had peritonitis and was controlled by penicillin, exercises as soon as they were fit to. They the legs and were instructed to be sitting than lying.

### SUMMARY

Early ambulation is advocated as sound post operative care in point of view of physiology, psychology and economy to patient and hospital. Hospital accommodation is conserved and patients return to work early with very pleasant memories of their surgery. The nursing staff have very little responsibility of any nursing that would otherwise have been necessary in bed-resting patients. Hazards of major surgery like atelectasis, hypostatic pneumonia, phlebothrombosis embolism, asthenia, ileus and other gastro-intestinal complications are seldom seen. Post-operative complications do depend on age, type of operation, and nature of disease. Ambulation alone, does not answer all points.

The patient's morale is fine throughout, with no anaesthesia or decubitus. Catheterisation, cnemata and sedatives are seldom necessary.

With present day advances in technique and availability of fine ancillaries like penicillin and sulphadruugs in control of wound infection, early ambulation should be established rather than challenged.

Indications are "Good Risk" patients as understood by a modern surgeon.

Contra-indications are cases of peritonitis, haemorrhage, shock, etc.

Transverse incision and non-absorbable sutures are recommended.

Morale and economy considerations are good in patients' point of view.

This regimen is not to be understood as one of a forcible flat compulsion of the patient to get up and walk.

Encouraging and reassuring patient-contact are essential in achieving success in getting patients out of bed.

### CONCLUSION

An attempt has been made to define the technique of early ambulation.

The advantages, the indications and contra-indications are brought out.

Experience in a small series of cases is the basis of our enthusiasm in presenting this paper.

These patients look after themselves, and demand very little nursing.

Surgery is not viewed with horror by these patients.

With this programme in full swing, the task of the surgical unit is very simple in the post-operative period.

### POST SCRIPT

Since reading this paper we have come across J. B. Blodgett & E. J. Beatties' article on "The effect of early post-operative rising on the recurrence rate of hernia." Their review comprising an analysis of 180 cases of inguinal hernia treated by post-operative bed rest gives a recurrence of 6.1%, whereas the recurrence rate in 150 early bed risers was 6%. They conclude that early rising does not significantly affect the recurrence rate of Hernia.

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## BONE GRAFTS

by MAJOR H. R. PASRICHA IMS/IAMC.

Nearly 88 years ago, in 1859, Ollier first published his results after performing a systematic examination of bone grafts. He believed that an autogenous graft was kept alive by its own periosteum until it became revascularised. In 1893, Barth came to exactly opposite conclusions. He reported that any graft, whether covered with periosteum or not, always became necrotic in all its parts together with its periosteum and endosteum and that the necrotic bone was regenerated by osteoblasts derived from the neighbouring sound bone of the host. These observations were refuted by Axhausen after the performance of several well controlled experiments and supported by the clinical experience of Lexer. According to them though transplanted bone necroses periosteum and endosteum do not necrose and they are responsible for regeneration of bone after they have become revascularised. Albee thought the fate of a graft depended upon its exact environment and that the chances of survival are increased by exact approximation of the graft with the host bone. He adds that periosteum and endosteum play an important role in establishing early and abundant blood supply. Murphy, however, believed that the graft is, per se, not osteogenic but osteo-conductive and regeneration cells are supplied from the osteogenic cells of the capillaries growing from the living bone of the host.

MacEwan also denies any osteogenic power in the periosteum. Leriche and Policard explain the regeneration of bone according to their theory of metaplastic processes. Regeneration is carried out by fibrous tissue cells which penetrate into the graft and are converted into osteogenic cells through metaplasia. Matti found that spongiosa bone shaved into small pieces and transplanted survives in all its parts. Its loose structure helps in quick establishment of circulation. He concludes that the transplantation of

spongy bone can be carried out successfully in non union.

During this war a large number of bone graft operations were necessitated by war injuries and performed by me at 7 I.B.G.H., Poona. Experience gained as a result has helped to convince me that the classical technique of bone graft as taught in books will have to be altered considerably if better results are to be obtained.

All the cases were compound fractures resulting from war injuries in the field. All of them had had benefit of efficient forward surgery,—penicillin and efficient splintage. The resulting non-union was invariably due to excessive loss of bone substance either initially or later on due to infection.

In the beginning all cases were grafted according to the classical technique advocated in most orthopaedic books. They were all tibial grafts removed with the help of an Albee's saw and fixed with the help of stainless steel screws. All cases were done under Penicillin umbrella and no cases developed any kind of sepsis; all healing was by first intention. It was felt, however, that bone grafts took a very long time to unite securely although the parent bones were small long bones, like the Radius, in most cases. Also, even when the graft united, which it did in all cases, there was not much evidence of new bone formation around it for months. This left the bone weak and liable to easy refracture.

The following representative cases in this series will illustrate the point. In some of these cases the grafts were fixed with steel wire. Although it does not seem to have made much difference in union, this method of fixation is not advocated. It had to be adopted on account of war scarcity of medical appliances which became unavoidable at certain periods.

## Case 1. (Fig. 1.)

R/M L.S. 1/10 G. Rifles—sustained G.S.W. left forearm on 11-5-'44 Comp. Fracture both Radius and Ulna. Extensive lacerated wound dorsum of Lt. Radial and Median nerve lesions also. Admitted 7 I.B.G.H. on 8-9-'44; un-united fracture Radius—Ulna united. Wrist drop and signs of median lesion present. Wound still discharging. Sinus healed on 10-1-45. Tibial bone graft inserted between freshened bone ends on 12-9-45. Cortical inlay fixed with wire. Graft united on 11-9-46.

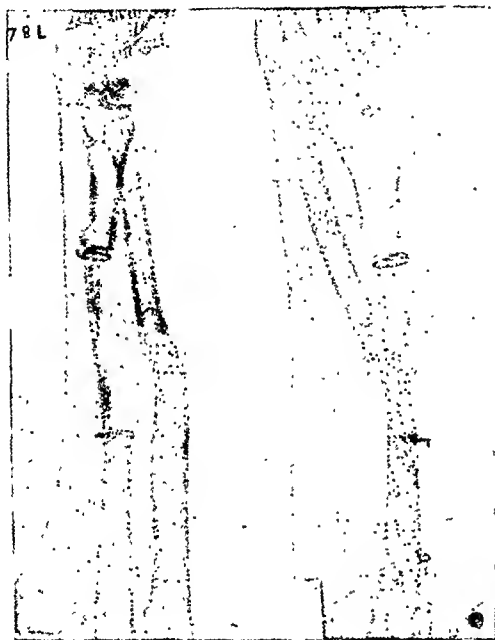


Fig. 1.

## Case 2. (Fig. 2.)

L/Nk B.R. 6/7 Rajput regt. sustained G.S.W. of left forearm and comp. fracture of Radius (2-3-45) admitted to 7 I.B.G.H., on 22-6-45. No union of Radius. Arm still in P.O.P. Signs of recovering lesion of Median nerve. Thenar muscles still wasted and not functioning—Time was given for the nerve recovery to take place. Bone graft on 25-1-46. Tibial graft inserted between freshened bone ends. Fixed with screws. Cortical inlay. Graft fully united on 6-9-46.

## Case 3. (Fig. 3.)

Jem. H.R. 2/10 G.Rifles G.S.W. wounded in C.M.F. on 19-4-45 Compound comminuted fracture lower third Radius. Wound excised. Delayed primary suture with Penicillin. Admitted to 7 I.B.G.H., on 1-10-45. X-Ray showed a gap be-

tween fragments of Radius. Wound healed. Median nerve lesion. By 24-4-46 Median nerve had recovered considerably. Operated on 29-4-46. Gap 10½" Tibial graft inserted and fixed with screws. Cortical inlay. Graft fully united on 8-10-46.

## Case 4. (Fig. 4.)

R/M N.L. 2/8 Gurkha Rifles Wounded on 17-12-44. G.S.W. left arm: compound fracture shaft Humerus lower third. Wound excised. Secondary suture with Penicillin.

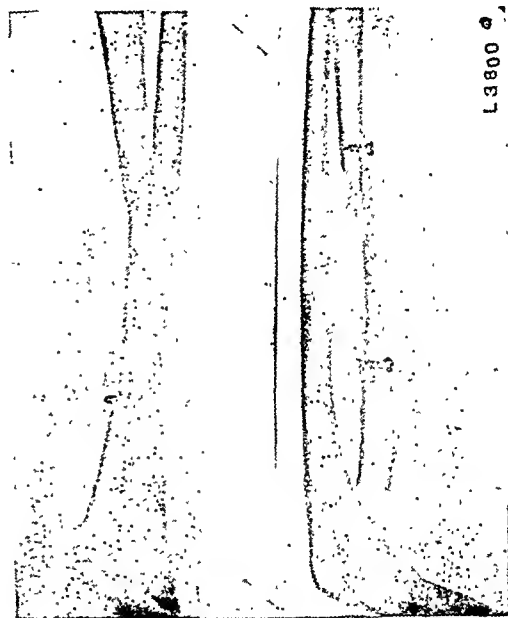


Fig. 2.

Admitted 7 I.B.G.H., on 23-4-45. On removal of P.O.P. X-Ray showed un-united fracture Humerus and Sclerosis of bone ends. Operated on 18-6-45. Gap 10 cms. Bone ends cleared. Two Tibial grafts inserted and fixed with steel wire. Graft united on 26-4-46.

The results of these cases were obviously disappointing. The grafts took 12, 8, 6, and 10 months to consolidate and even then there was not enough new bone formation around the grafts to entitle them to be considered secure. It was clear, on a review of the results of this series, that cortical graft, per se, did not possess sufficient osteogenic power and had to be re-inforced by tissue which would stimulate more bone formation. The answer was spongy bone. In the next series, therefore, all cortical grafts were re-inforced by spongy bone. The results were encouraging, only two cases of this series are quoted here.

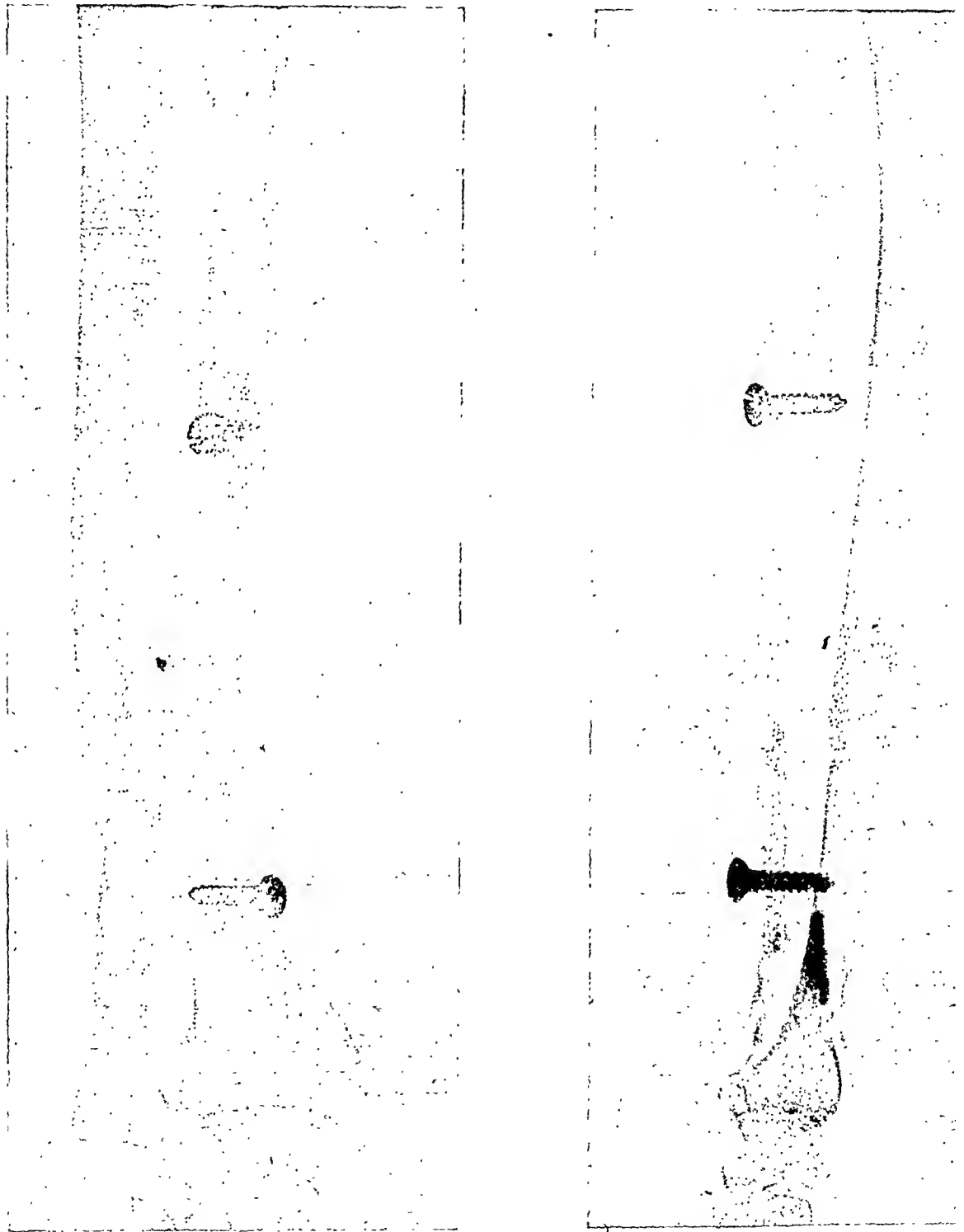


Fig. 3.

## Case 5. (Fig. 5.)

Hav. R.C.C. 1/5 M.L.I. wounded on 19-10-44 shell wound. Large wound back of Lt. Arm with compound fracture left Humerus, lower third. Wound explored and cleaned on 20-10-44 at 8 C.C.S. Fracture Humerus and Radial nerve completely torn. Thoraco-brachial P.O.P. Transfer received in 7 I.B.G.H., on 23-4-45. Still in P.O.P. Radial palsy present. X-Ray shows no union of bone at all. W.R. & Kahn negative. Operated on 29-5-45. Bone ends exposed and freshened. Very small lower fragment. Tibial cortical graft inserted and fixed with screws. By 16-4-46 it was apparent that though graft had taken firmly at the upper end, it failed at the lower end.

2nd operation on 5-8-46. Bone ends exposed and excised. Large tibial graft fixed with the help of stainless steel screws. Gap filled in with cancellous tissue. On 21-4-46 the graft was already showing signs of union and new bone formation.

## Case 6. (Fig. 6.)

R/M B.B. 3/1 G.R. Wounded in Burma on 5-2-45 G.S.W. Supra-Condylar fracture of Hume-



Fig. 4.

rus and Radial nerve palsy. Operated on 21-3-45 at 130 I.B.G.H. at Lucknow. Lower end of Humerus found projecting through the wound. Necrosed. Vaseline gauge dressing. Operated on again on 12-3-45 at the same hospital. Projecting lower end of Humerus was excised and arm put up in P.O.P. X-Ray after operation showed pos-

terior displacement of lower fragment 30-5-45. No union at all. Transferred to I.B.G.H. on 19-6-45. Un-united fracture Humerus. X-Ray shows a big gap. No likelihood of union. Elbow ankylosed. A big scar on the anterior aspect of elbow and lower part of arm. Scar excised and a pedicle graft of skin transferred to the arm. By 6-5-46, the skin graft had taken well. W.R. and Kahn negative.

Operation on 31-7-46. Bone ends exposed. Lower fragment very small. One Tibial Cortical graft fixed with screws. Intervening gap filled in with cancellous tissue removed from the Ilium. By 30-11-46 graft was showing good union.

## DISCUSSION

The first case is interesting because it had both varieties of grafting operations performed. A cortical tibial graft in the first instance failed to unite at the lower end. When combined cortical and cancellous grafts were used good bone formation resulted in 3 months. Similarly in the

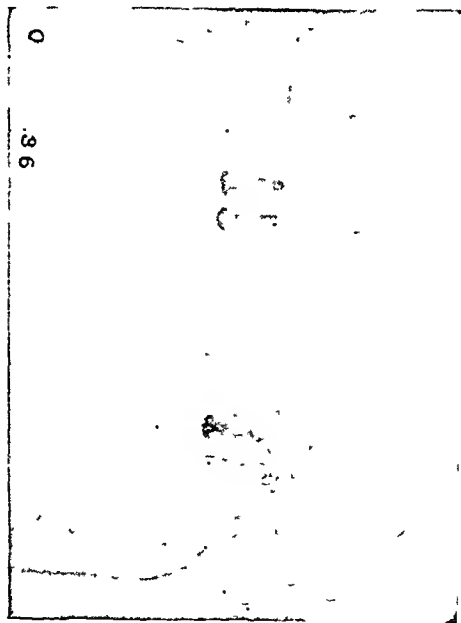


Fig. 5.

second case enough bone formation was in evidence in 4 months to pronounce the graft a success. After this another change in the technique was introduced. It was certain by now that the cortical graft, per se, possessed little osteogenic power and, probably,



served no other purpose than that of general support and holding the fragments together. It was considered likely that a metal plate could perform both these functions more efficiently. This would incidentally, simplify the technique by omitting the removal of a graft from tibia. In the next series, therefore, the freshened bone ends were held together by a plate and screws and the intervening gap between the ends filled with cancellous tissue removed from the Ilium. Three cases of this series are included.



Fig. 6.

#### Case 7. (Fig 7.)

Sep. SS 7/8 PR wounded in Malaya on 11-2-42 G.S.W. left arm Fracture Humerus Became a prisoner of War Released in 1944 On 10-5-41 fracture still un-united Has had Beri-Beri Still has a discharging sinus in the middle of arm inspite of having had an operation of sequestrotomy during captivity Transferred to 7 I.B.G.H on 25-10-45. X-Ray shows non union Discharging sinus present Sequestrotomy on 1-3-46. Sinus

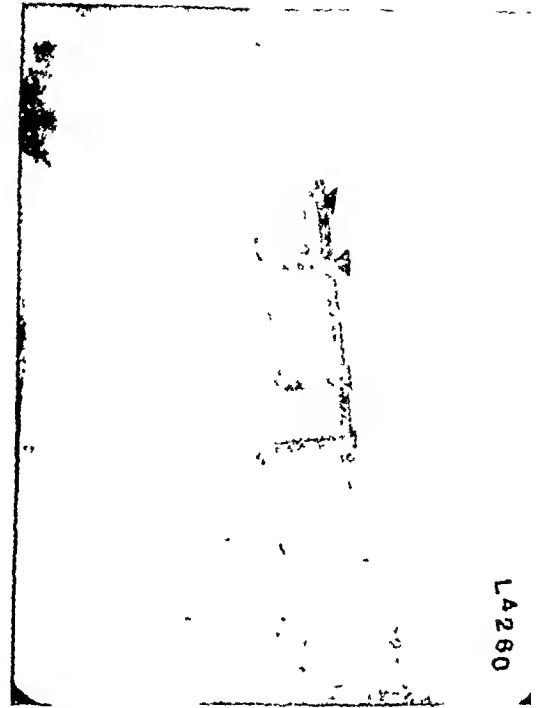


Fig. 7

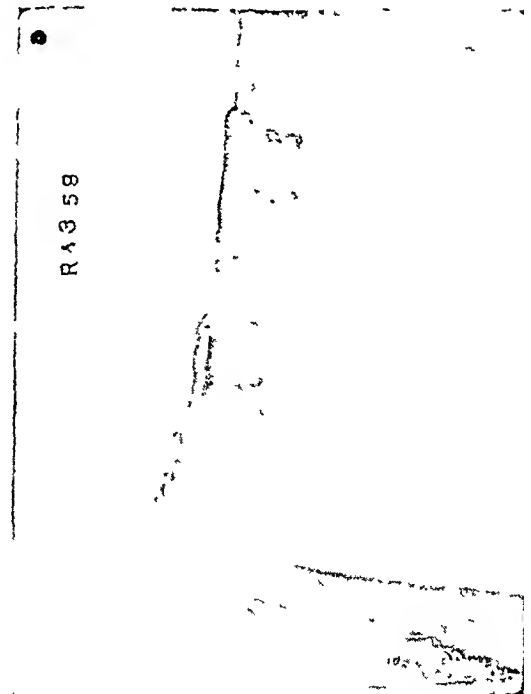


Fig. 8.

closed subsequently. On 16-4-46, operated on again. Bone end exposed and freshened. Bone ends held with the help of a plate and screws and the gap filled in with spongy bone from the Ilium. By 26-11-46 graft had united well and there was plenty of new bone formation.

Case 8. (Fig. 8.)

L/Nk T.B. 1/4 G.R. wounded in Burma on 25-11-43. Grenade wound Rt. Arm with compound fracture Rt. Humerus, penetrating elbow. Grossly

cancellous bone from Ilium. By 12-10-46, union was complete.

Case 9. (Fig. 9.)

L/Nk M.S. 4/7 R.R. wounded 9-4-45 G.S.W. left thigh and Rt. heel. Fracture lower 3rd left femur and os calcis (Rt.) Wound cleaned and explored the same day at 19 C.C.S. Excision, loose pieces of bone removed. Put up in Tobruk P.O.P. Transferred to 77 I.G.H. on 14-4-45. Skeletal traction



Fig. 9.

lacerated wound. Disorganisation of elbow joint comminution of upper ends of Radius & Ulna. After having been treated in various hospitals, he was finally transferred to 7 I.B.G.H. on 2-5-45. No union at all, big gap between bone ends. Multiple sequestra. Sinuses discharging. Two operations of sequestrotomy cleared up sepsis and sinuses closed. By now elbow completely ankylosed. Operated on 9-4-46. Bone ends exposed, freshened and held together with plate and screws. Gap filled with



Fig. 10.

through Tibial tuberosity applied. Secondary sutures to wound on medial side with penicillin. Lateral wound cleaned, two pieces of dead bone removed. Sutured with drainage. Traction 15 Lbs. in a Braun's splint.

19-5-45 wounds healed. X-Ray shows postero-displacement of lower fragment. Attempts made to correct displacement with the help of pads proved of no avail.

Transferred to 62 I.G.H. on 17-8-45. Patient now showed signs of peroneal nerve palsy probably due to the pin.

Transferred to 7 I.B.G.H. on 8-12-45 X-Ray shows a big gap between fragments with only a narrow ledge of sclerosed bone. (Fig. 9.)

On 13-8-46 patient slipped and broke the femur. Operated on 16-8-46. Bone ends exposed and freshened. Gap at least 2" approximated as far as possible and held together with a vitallium plate and screws. Intervening gap filled with cancellous graft P.O.P. hip spica.

By 6-11-46 although union was not complete enough bone formation had occurred to call the graft a success. (Fig. 10.)

## DISCUSSION

These cases show that though the Tibial graft was omitted and replaced by a plate, the results continued to be eminently satisfactory and the period required for new bone formation and consolidation was considerably reduced. Obviously the next step was to try and see if the internal fixation could be dispensed with altogether. It was realised that doing away with internal fixation altogether in case of certain bones would not be devoid of risk, e.g. Femur and Humerus for the simple reason that our methods of external fixation in these two bones are not satisfactory. Hip and thoraco-brachial spicas do not secure complete immobilisation of these bones. Forearm and leg bones can be effectively immobilised by external methods. It was, therefore, decided to employ this technique in the latter bones only. This technique was used concurrently with the other series. Only one case is described in detail here.

### Case 10.

Rect. R.S. 2 M.T.T.C. Involved in a lorry accident on 25-7-42. Compound fracture Tibia and Fibula (Rt.). Admitted to 8 I.B.G.H. on the same day. Deep wound (12 x 6") Rt. Leg with gross damage to muscles. Bone ends of Tibia exposed. Gap atleast 2". Excision Vaseline gauze dressing P.O.P.-A.T.S. given. X-Ray showed comminuted fracture of middle of shaft of Tibia & Fibula. Fragments wide apart indicating loss of bone. 15-2-43

operated on. A cortical bone graft was taken from left Tibia and inserted into Rt. Tibia.

29-9-43 X-ray showed separation of fragments with the graft showing in between.

25-2-44. There is obvious absorption of graft. No sign of new bone formation. No union.

12-10-44. Admitted to 7 I.B.G.H. Discharging sinus present although the notes do not say so. The bone graft has almost completely disappeared. (Fig. 11.)

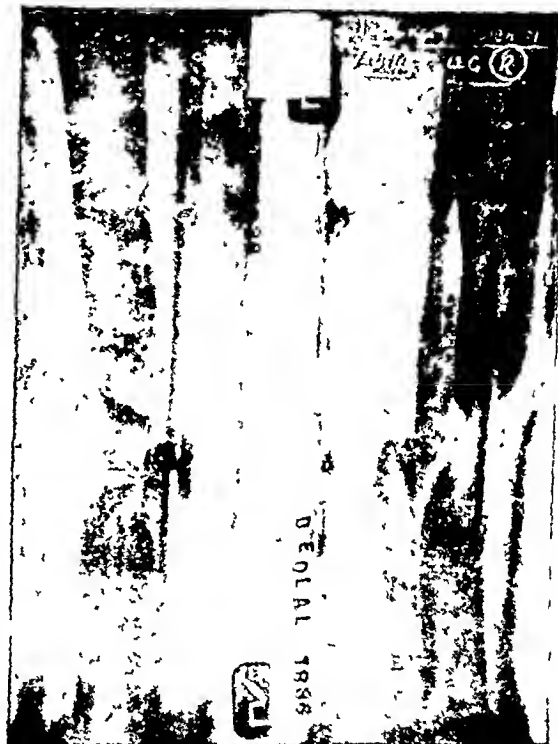


Fig. 11.

9-3-45. Has formed an abscess locally. Opened up. A few days later the graft was extruded.

26-9-45. Wound finally healed up.

5-2-46. Operation. Bone ends exposed and freshened Gap 3". Gap filled in with cancellous bone from both ilia Soft tissue sutured over. P.O.P.

26-9-46. Tibia has united firmly, but Fibula remains un-united. (Fig. 12)

## DISCUSSION

This case shows that firm fixation is necessary in cases of cortical grafts. The first graft in this case had no chance of taking because apparently no method of firm fixation was used. Obviously, close approximation without firm approximation is not



enough. The same, however, does not seem to be true in case of cancellous graft. On account of its superior osteogenic power it can unite even though no form of internal fixation either of the ends of the host bone or of the host bone and graft is employed.

### CONCLUSIONS

1. From these results it is obvious that cortical grafts by themselves have very poor osteogenic power and, in main, they serve no other purposes than of holding the fragments together till osteoblasts from the ends of the host bone and cancellous tissue taken into the graft accidentally during removal can regenerate bone. Very likely, good results reported with cortical grafts in the past were due to a certain amount of cancellous tissue removed along with the graft. Cortical grafts take a long time to consolidate and longer still for enough new bone to be formed to reconstitute the girth of the bone. In bigger bones this is a matter of a year atleast.

2. This prolonged period of immobilisation adds another problem to that of reconstitution of bone; the problem of restricted movements in the immobilised joints. It has been our experience that it takes several months for the joints to recover enough movement to restore the function of the limb to a reasonable degree.

3. Cancellous bone is far superior to cortical bone as a graft. It has much greater osteogenic power. The graft takes easily and the host bone is reconstituted much earlier, thus reducing the period of immobilisation of joints. The function of the limb is restored much earlier.

4. In bigger bones, e.g., Humerus and Femur the ideal method would be to use a plate and screws to hold the bone ends together and fill the gap with cancellous bone which is easily removed from the Ilium. In other bones like Tibia and Radius cancellous tissue alone would seem to be quite sufficient for reconstitution of bone.

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## CASES & COMMENTS

### A CASE OF TOTAL PNEUMONECTOMY\*

by J. A. DHACKA

Removal of the lung has been an established procedure since the days of McEwan, and studies by Kayne, O'Shaughnessy, Tudor Edwards, Reinhoff and many others have put the operation of Total Pneumonectomy on a more scientific and studied technical basis.

As a well planned operative procedure, total Pneumonectomy has been advocated and successfully performed for :

1. Suppurative diseases of the lung.
2. Bronchogenic Carcinoma.
3. Tuberculosis of certain types.
4. Extensive laceration of the lungs and uncontrollable bleeding including the hilar tear.

Cases of the last group are few in proportion to the published series in the first three groups, because traumatic cases may not have presented themselves in time for a successful operation. Further, the clinical picture presented by these traumatic cases might have exhibited complex syndromes due to concomitant injuries to the vital adjacent mediastinal viscera so that quite many of such cases may not have come to the operation table having died during the observation and resuscitation stages; the modern teaching and practice of ultra conservatism in the treatment of Thoracic injuries may also have partly contributed to the paucity of the last named group in the published cases.

The case reported herein is meant to illustrate the difficulties that a surgeon may come across in the emergency treatment of intra thoracic bleeding of unknown origin; planning of the operation is out of the question, attendant facilities such as modern methods of anaesthesia are not available, expert assistance during the course of operation is rare, and methods of resuscitation

of cases, pre operative and post operative, are not always ideal or administered in time.

#### CASE REPORT

EFR No. 17002 — 8416. Name : Shankar Ramachandra, Hindu, Male, Age 25. Was brought to the Blood Bank of the J. J. Hospital at 3-30 p.m. on 23-12-46 from the casualty department (where he was admitted at 3-20 p.m.) with the following notes :

"Assaulted with knife, incised wound  $1\frac{1}{2}$ " x 1" x ?" on the left side of the chest 2" below the clavicle. Patient under severe shock. General condition bad. A.T.S. morphia given."

On examination he was in an extreme degree of shock. Skin was cold and clammy, perspiring all over. Tongue, nails and conjunctiva were pale, the pulse was feeble, thready and of low tension, the rate was more than 150, respirations were 38 to 34 per minute and there was marked air hunger.

Local examination revealed a stab wound  $1\frac{1}{2}$ " x 1" x ?" in the left second intercostal space medial to the left mid clavicular line. There was



Fig. 1.

profuse bleeding from the wound over which a sterile pack of dressing had been applied. There was no surgical emphysema, the respiratory excursions of the chest were limited, the percussion note

\*From the surgical wards of the Sri J. J. Hospital, Bombay. The author acknowledges with gratitude the valuable help rendered by the Staff of the hospital.

was dull and the breath sounds were absent on the left side.

The resuscitation of the case was left to the Medical Officer in Charge of the Blood Bank, and as requisition for plasma and blood necessarily involved some departmental delay, the only resuscitation method possible was administration of intravenous glucose saline which was started; about two pints were given without any appreciable change in the condition of the pulse. Unfortunately proper blood was not available and plasma could only be got with considerable delay after the operation.

The patient was brought to the operation theatre only at 4-45 p.m. as the Surgeon was operating on a stab wound of the abdomen. During transport from the blood bank to the operation theatre, the saline needle slipped out; the patient's pulse had hardly improved even after 2 pints of glucose saline had been given.

An intra tracheal tube was passed by the anaesthetist (Dr. Danak) and during the passage of the tube, as usual the patient gave a violent cough and about 150 to 200 c.c. of blood shot out through the stab wound partly in clots and partly liquid. The patient had now become pulseless and had stopped

breathing. 2 c.c. of intra-cardiac Coramine was given. Many unsuccessful attempts were made to put the saline needle into the collapsed vein till finally the surgeon dissected out the right saphenous vein and saline was started. Patient showed signs of revival with a few gasps of breathing, but hardly any tension about the pulse was noted.

*Operation Notes (J.A.D.):* In stab wounds it has been my experience while operating on cases during the repeated upheavals of civic unrest in the city of Bombay that it is best to follow the stab ignoring the conservative methods of approach to different viscera. Moreover the direction of the wound in its depth pointed towards the mediastinum. Hence a curved skin incision as shown in Fig. 1 was made curving over the second to the sixth costal cartilages. The muscles, costal cartilages, and parietal pleura were cut in one line with bone scissors, and, as expected, the thoracic cavity was found full of blood. The hands of the assistant provided a suitable retractor of the trap door, as no ribs were cut. The unavailability of blood and plasma at the time necessitated the mopping out and collection of blood from the thoracic cavity; this blood was citrated and used as auto blood transfusion. About 800 c.c. were given. After the mopping up, a through and through oblique stab

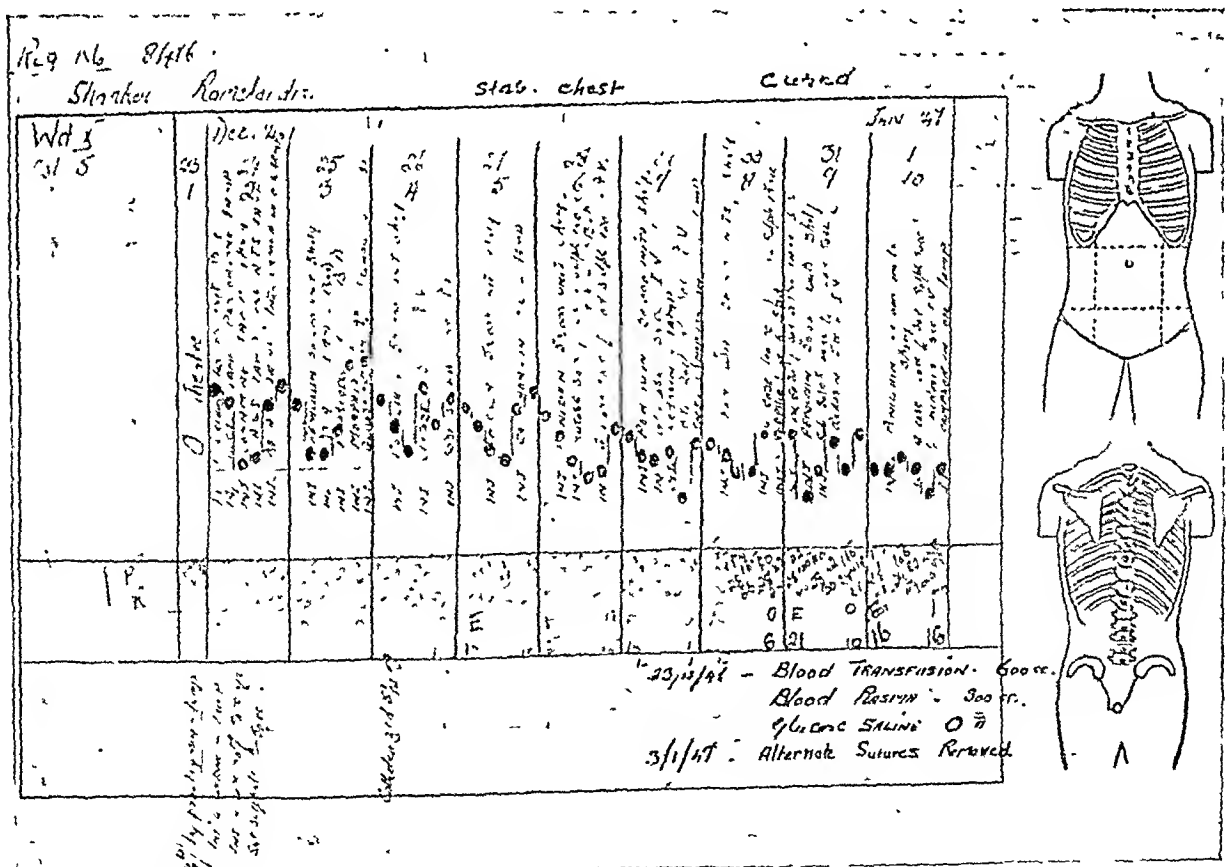


Fig. 2.

wound, 2" in length, and admitting the index finger, was noted extending from the anterior surface of the left lung to the mediastinal surface in front of the upper border of the hilum. On mopping further, a fresh gush of blood from the mediastinum was provoked and instinctively the left hand was passed keeping the dorsal surface of the hand against the mediastinum and feeling the pulsating heart on the dorsum of left hand from underneath the left pulmonary ligament thus engaging the structures of the hilum between the index and middle finger and controlling the bleeding from the hilum by adductor grip of the first two fingers. Slackening the grip of the two fingers revealed fresh bleeding from the upper pulmonary vein which lies in front of the bifurcated main

bronchus and from a tear in the left pulmonary artery. A large, curved pedicle clamp was applied from above downwards medial to the "Finger Haemostat"; the thoracic cavity was mopped dry and remained dry. A large curved blunt pointed aneurysm needle was threaded with long No. 4 silk and a transfixation suture was placed medial to the clamp, the pulmonary artery, upper bronchus and upper branch of the pulmonary vein occupying the upper circle and the lower bronchus and pulmonary vein occupying the lower circle of the suture, and a surgeon's knot was tied home relaxing the clamp during the process of tying. The ligature was left long for a time and the collapsed lung was excised by cutting with Mayo's scissors from above downwards lateral to the curved blades of the



Fig. 3.





5. One pint plasma.
6. Morphia 1/6 gr. with Atropin 1/150, 6 hourly, 3 times.
7. Intra-venous glucose 50 c.c. 25% with Vitamin C daily.
8. Nursed on back in semi-reclining position.

#### 2nd week :

1. Same medication continued.
2. Patient developed symptoms of Nephritis which was symptomatically treated.

#### 3rd week :

1. Oedema disappeared.
2. Urine normal, blood pressure 105/80.

Temperature touched normal for the first time on the sixth post operative day. (Vide: Temperature Chart Fig. 2.) Pulse rate came down to 100 on the sixth post-operative day and the respirations to 26. Amount of urine ranged about 32 oz for 24 hours. Alternate stitches removed on the 12th post operative day; all stitches removed on the 16th day. On the 17th day, the patient tried to sit up on the bed and this caused partial dehiscence of the wound which was strapped by Elasto plast.

#### 4th week :

Most of the medications stopped.  
Skiagram of the chest taken 49 days after operation is shown in Fig. 3

#### Cardio-Respiratory Studies

1. Electro Cardiograph report :—  
Vide Chart. Fig. 4.
2. (a) Vital capacity 1700 c.c.  
(b) Respiratory rate 23 per minute.  
(c) Supplemental air 900 cc.  
(d) Complemental air 800 cc.

#### 5th week :

Patient developed slight jaundice with the following findings and was treated in the usual way :—

- (a) Serum Bilirubin 8 mg.
- (b) Icteric index 40 units.
- (c) Vandenberg reaction direct positive.
- (d) Bile pigments present in urine.
- (e) Bile salts absent in urine.

#### 6th week :

1. Jaundice disappeared.
2. Most of the medication discontinued.
3. Plasma proteins total 6.10, Albumin 3.10, Globulin 3.00.

### SUMMARY

1. A case of Left Total Pneumonectomy is reported.

2. The rarity of cases of total pneumonectomy for injury is possibly due to the cases arriving too late for successful surgical aid and to the attendant injury to mediastinal structures.

3. Mass ligation of the hilum was done in this case without the usually dreaded complications.

4. Pleuralisation was not done.

5. Drainage dispensed with for the following reasons :—

(a) Fear of total pneumothorax during post-operative period and bad management of the drainage tube.

(b) Limited utility of any drainage due to blocking after 24 hours.

(c) Leaving the tube for a few days leaves the stab hole as a button-hole with the attendant dangers.

(d) If exudate forms, then it can always be aspirated.

6. With firm closure of the bronchus, the possibility of tension pneumothorax was but little, but in view of the above the risk was taken.

7. Massive use of penicillin contributed considerably to the successful recovery of the case.

## ASSOCIATION NOTES

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### Proceedings of the IX Annual Conference of the Association of Surgeons of India

The IX Annual Conference of the Association of Surgeons of India, was held on the 26th, 27th, 28th and 29th December 1947 at the J. J. Hospital, Bombay. During the same week, various Medical Organisations also met at Bombay in the same compound.

More than one thousand five hundred doctors who represented the various Associations had a happy and profitable time.

Our Conference, which was very well attended was, as usual, a grand success.

Rao Bahadur Dr. M. G. Kini of Madras presided and Drs. Arthur DeSa' and V. P. Mehta were the Local Secretaries. They were helped by a group of Student Volunteers from the Medical Colleges

at Bombay, and the arrangements made for the accommodation and transport of the visiting members were excellent.

The formal inauguration of the Conference took place on the 26th December at 9 A.M. in the Conference Pandal. The Hon'ble Dr. M. D. D. Gilder, M.D., F.R.C.S., etc., Minister of Health and Public Works, Govt. of Bombay, declared the Conference open.

In his inaugural address, he appealed to doctors to remember and stand by the "humble" ideals of the Medical Profession. Dr. Gilder said, Conferences of that kind not only helped members to listen to Scientific papers read by eminent Doctors, but also, what was more important, enabled them to establish contact with doctors from all over the country.

Referring to the paucity of Surgeons in India, Dr. Gilder said, there was difficulty whenever an important post of a Surgeon had to be filled in. It was his constant "headache" to create Surgeons to train them up and to keep them "up to date". There were hardly any facilities for adequate training in the country.

The primary function of a University, as far as Medical Education was concerned, Dr. Gilder declared was to produce a large number of "good Medical Practitioners", who would tackle common emergencies and ordinary illnesses. He could not understand why there was such a very large number of failures in the Medical Examinations of the Bombay University. He asked "is it because of poor teaching, or of the high standard of the tests or of bad material?"

Dr. Gilder welcomed the suggestion made by the Hon'ble Mr. M. C. Chagla, Chief Justice, that Examiners should be appointed by a Public Service Commission.

Then, Rao Bahadur Dr. M. G. Kini, in his Presidential Address said :—

### PRESIDENTIAL ADDRESS by M. G. KINI

It is indeed a rare honour and privilege that has fallen to my lot that the Association of Surgeons of India should have elected me as their President for this year. This is a momentous and epoch making year on account of the fact that we as a nation have undergone a transition in our phase of life from dependence to independence and it is my hope that the Association of Surgeons which was started nine years ago for the furtherance of independence in thought and deed about the art and science of surgery in our country will get an added stimulus to raise the standard of surgery in

India to the level obtaining in other parts of the world and will find an honourable place in the surgical map of the world.

Another notable feature of this year is a gathering of all medical men in India in a medical-conference and festival for the first time. With the experienced gained, it should be possible to devise plans for such common meetings at least every 5 years. It is, however, my opinion that specialist conferences must not lose their identity and must carry on their specialist good work to raise the standards of medical relief on a competitive basis, and also be of use to the general practitioner. Once in 5 years all the specialist conferences must pool their resources for mutual advantage and at the same time be of use to the general practitioners in enlightening them on the advances made.

I may be forgiven, if I strike a personal note. I feel proud that Bombay which gave birth to this Association of Surgeons of India has given me the rare honour to preside over this function in Bombay, where it is meeting for the second time. It is here that I read my first paper on the work I had begun to do. Bombay, a cosmopolitan city, always welcomes and attracts people of all presidencies and businesslike in its methods, evaluates the merits and demerits and is generous to a fault without any sense of parochialism. I do not know whether I will come up to the standards which have been laid by my predecessors in this chair. With your help and co-operation I will try to discharge my duties to the best of my ability.

My predecessor has gone through the history of surgery including evaluation of the present standards. I wish to speak on some of the fundamental aspects of medicine in general and surgery in particular as it affects the profession due to altered circumstances in our country to-day.

### Problem of Indigenous Medicine

Evolution of medicine from its crude conception to the modern attainments deserves a retrospect to understand perfectly its scope and usefulness in the solution of the problem of human ills. Time was when human beings in their desire to save life from acute infections and diseases invoked spirits, practised incantations and sacrifices with the object of appeasing the spirits. Later, when human intelligence improved and division of labour occurred in the community, a medicine man appeared on the scene who in addition to invoking the spirits, tried plasters, used infusions, decoctions and various vegetable and mineral drugs.

Thus, the medicine man was the first phase in the evolution of medical relief. Later, it led to the development of a medical profession. There were certain landmarks during the progressive evolu-

tion, when great men of thought in medicine, by their attainments and clear thinking, developed centres of learning, and tried to pull out medicine from the quagmire of superstition, empiricism and sophistry. From time immemorial, the medical profession has exercised its beneficent sway for the relief of the diseases without distinction of caste, creed or race. Whenever any progress has been made in any sphere of its activities, it always tried to disseminate knowledge for the cure of diseases about which ignorance prevailed. When medical men became secretive, and commercialised their knowledge, medicine became degenerate, and unauthorised people began to practise magic cures by free advertisement. Thus, the science and art of medicine was pulled down from its high pedestal, retaining only the fictitious halo of glory of its usefulness. These are the reasons which led to the decadence of ancient medicine including our indigenous medicine. The progress of the modern phase synchronised with the renaissance of all basic sciences when it began to investigate into the mysteries of nature, revealed by experimental investigations and clear observations and by a study of the whys and wherefores of things observed. Astronomy, Physics, Chemistry, Biology, in their awakenings had rude shocks and vicissitudes through which they had to pass due to religious barriers and conservatism which were predominantly prevalent at the time. But science could not be trampled upon and it ultimately triumphed due to the strenuous efforts of savants who sacrificed their lives and their all in the cause of this noble objective.

Medicine from its empiricism of the use of mere plasters decoctions, drugs and various methods of treatment, flowered into a science when it began to accept scientific concepts of physics, chemistry and biology. Knowledge of chemicals led to their scientific application in the prevention and cure of disease. Medicine in its evolution had stages of progression and retrogression corresponding to political upheavals, invasions and natural causes due to inherent defects. A clear and better understanding of the structure and function of the body and its relation to heredity and environment has evolved a better scheme of natural health. A knowledge of the living organisms both beneficent and malevolent to human beings has helped both in the curative and preventive aspect of disease.

Split minds in medicine exaggerating the usefulness of things of the past by comparing with the conditions obtaining at each period, must have existed and are still existing. The Indian Nation which is passing through a renaissance period of nationalism has also got its split mind in evaluating the methods of medicine. Everywhere there is a keen desire to progress in scientific efforts. In Industry, in Agriculture, in Engineering, efforts are being made to come into line with the progress that is obtaining in other countries. In medicine alone, it is unfortunate our people are ranged

between two schools of thought. One is for the revival of the old systems of medicine to be put on their former pedestal which some of the great nationalists think is the ideal thing to do as they honestly believe that nationalism means revival and consecration of the old heritage of the people of India. This view is shared by a large number of people both educated and uneducated and freely expressed everywhere from the platform and on the floors of the legislatures. The one theme of the song of these people is to go back to the days of old which were glorious. The other school of thought in the national renaissance is taking a stronger view and is quite inimical to the above mentioned outlook as it is convinced that to go back to the old conception of disease and its approach to treatment is fatal, uneconomical and dangerous to public safety. It also points out that we are passing through a phase in the evolution of human progress which is not narrow in its conception as all barriers of distance, time and space are overcome and contact with the outside world is a real thing. This aspect is illustrated by quoting the progress attained by the U.S.A., the U.S.S.R. and other western countries. These countries used to be devastated by famines and pestilences in the past; but now by adopting modern trends in medicine they have been converted into fruitful gardens ensuring better health and wealth for the people. These are held out as ideal centres of real and positive health. Industrial and Agricultural enterprise, building of big canals, irrigation and power projects have all been made possible by attention to preventive aspects of medicine more than curative. At present the national conception is to afford medical relief to the poor unfortunate people in the villages and urban areas in the cheapest possible way and in our anxiety to speed up the relief our bleeding hearts lead us to voice from the platforms that the western system of medicine is expensive and unsuited to the local people and therefore it is necessary to revive the old and simple medicine because it is cheap and effective and natural to the soil.

The simple medicines that are being advertised have not remained so simple. They are being exploited and kept a secret to the disadvantage of the individual concerned. They are advertised in full page colourful advertisements in the lay press with a view to sway the minds of the public. Some of the drugs attractively bottled and labelled are harmless and those that are harmful easily go out of the market due to medico-legal consequences following their use. In countries where Coroner's inquest system exists, it has an effective check on the sale of harmful drugs. A check is also found in countries where the Drugs Act is enforced vigorously as in America. Unfortunately in India these types of checks are lacking though attempts are being made to have an effective check.

In all basic sciences like Physics, Chemistry, Biology the outlook is universal. There is no such

thing as English Physics, Russian Chemistry and American Biology. Any advancement in the knowledge of these basic sciences that occurs is disseminated through lectures, essays, research papers, articles and books. Why should medicine alone be subjected to narrow parochialism when the benefits of medicine are universal?

In both ancient and modern medicine, when secret formulae form the bulk of medicine, they bring down the efficacy of the medical science and also confuse the minds of the lay public. To remedy this defect, the Mother of Parliaments set up a Commission with regard to the advertisement of patent medicines in the lay press. A Select Committee was set up in 1914 which arrived at definite conclusions which could not be effectively put into action. It was the lament of PROF. CLARKE, the noted Professor of Pharmacology, that even the House of Commons could not push through any legislation due to vested interests. Newspapers derived a large income from these large scale, prominent and attractive advertisements. Such advertisements offer sufferers from all and sundry diseases, miraculous cures, offering beans, tablets, wines, salts, powders, pills, ointments, hormones and gland extracts to reduce weights, to slim or to increase fat, to increase stature, to restore youth and sex potency, to dissolve stones in the gall and urinary bladders, indigenous Rasayanams, Lehyams and Makharadwajas. In short from a common cold to a child birth such fantastic advertisements are found to sway the minds of the gullible public, who buy these medicines more often imagining ills by reading the advertisements. If it is difficult in Great Britain to initiate legislation it is more difficult to legislate in India where different systems of medicine are practised without any control. However as a result of agitation in Parliament about patent medicines, one thing evolved in Great Britain, namely, that the cures for cancer and for venereal diseases were prevented from being advertised in the lay press.

Homœopathy and allopathic systems have standards abroad and it is the scientifically trained doctor who practises them. But in India Homœopathy is practised by all and sundry who become doctors of Homœopathy by reading books, or get spurious diplomas by correspondence without any basic knowledge of physiology, anatomy and basic sciences. Ayurveda and Unani have degenerated to quackery. Though there are savants in this line, this system has unfortunately been practised by quacks who through ignorance give not only wrong drugs but also dangerous drugs, imperfectly manufactured causing severe symptoms, sometimes with fatal results. This statement is made not as a frivolous attack on the indigenous system but to focus the attention of the public that it is necessary to bring order out of chaos.

Medicine should not be confused with mere drug administration. If it is the conception that drug

administration is medicine, then the whole argument for the rejuvenation of ancient medicine falls to the ground. If it is considered that medicine is progressive and advancing with the knowledge of ancillary sciences then the indigenous system of medicine should be brought into line with this ideal. The discovery of X-rays and Radium has led to the improvement of the diagnostic and curative aspects of medicine with which every person is well acquainted. The discovery of gases and other chemicals has led to the solution of anaesthetic problems and cure of diseases. The discovery of circulation and its publication in the year 1628 by HARVEY has led to a clearer conception about the vital fluids circulating in the body and many physiological problems based on the chemical constitution of the blood have been clarified. The evolution of blood transfusion may be stated to be entirely dependent upon this knowledge, though great strides occurred in the knowledge of the science and art of blood transfusion in recent years. The birth of Biochemistry has great potentialities and has already cleared many of the problems with regard to the body fluids both in health and disease. The discovery of the chemical composition of the crystalloids, colloids and vitamins is an example of the progress that medicine has made entirely based on the ancillary sciences. The pathological aspects of cells, cell lesions and environmental changes were all made possible by observations of biological aspects of the animal kingdom. In recent times chemotherapy has come to the forefront. The discovery of Penicillin has opened out new fields of thought. If Penicillin had been kept a secret then this drug would not have attained such efficacy as it has done now. By a lot of experimentation and extensive trials its usefulness has been established. A lot of time and money had been spent before its usefulness for the treatment of very serious conditions was found out with immeasurable benefit to humanity. Similarly new biological drugs have come to light and the literature that has grown round this subject shows the amount of critical survey from all angles with the sole object of attaining progress and also for probing into the possibilities of finding better and more potent and less harmful substitutes in the cure of severe diseases. This discovery of Streptomycin and the research to find out the scope of its use is another illustration. Thanks to research, it has been made possible to get purer Penicillin at cheaper rates.

Hormones and their manufacture in test tubes Insulin and its manufacture and use for diabetes are landmarks in the progress of pharmaceutical preparations.

The future of medicine depends upon a clear conception of the preventive aspect of medicine which brings positive health and is more beneficial to humanity than mere cure of diseases by bottles of medicine. At present there is a big race in

India and various systems of medicine are competing with each other. It has become a problem as to which bottle of medicine we are to dole out to the poor, ignorant, and helpless public. Is it the Allopathic, Ayurvedic, Siddha, Unani or Homoeopathic bottle that has to win the race? I hope our National Government will enunciate a new motto and a new principle. The outlook of a beneficial National Government *should be not to give a bottle of medicine but to give a bottle of good health.*

The belief that *Ayurveda* is "revealed" and cannot be bettered will be disastrous in the extreme. If *Ayurveda* is to be put on modern lines, we cannot think of doing it except by adopting modern trends of physiology, biology, physics and chemistry. It would be disastrous to think that Malaria is caused by humors and not by parasites. History tells us of the sacrifices made by medical men to learn the truth about Malaria. This has helped in the progressive development of preventive and curative medicine. The modern development of chemotherapeutic cures is an interesting phase and is an example of the value of developing medicine on scientific lines. The discovery of Atebrin, Paludrine, etc., are examples of the value of adopting modern ideas. More may be said of many other diseases which are devastating the countryside but which can be controlled by preventive and curative methods.

Such of the formulae and principles in the indigenous systems as do not come into line with modern medicine must be discarded and only those that can be utilised with advantage can be used for the benefit of humanity with more emphasis on the preventive aspects.

It is not the intention to decry our old system of medicine. It may be boldly stated that Indian Medicine and Indian Surgery at one time were far ahead of other countries which were practising medicine at the time but due to circumstances mentioned before they had fallen on evil days.

### Medical Relief in Villages

*Ignorance and superstition* are the predominant features of village life. To begin with, concerted action is necessary to improve this condition. Basic education, economic welfare and medical relief must work co-operatively.

In villages, people do not usually suffer from diseases which are common in urban areas. The smoothness of life is disturbed by *epidemics*, and quarrels which end in stabbing and murder. Traumatic accidental conditions also disturb the peace to a small extent.

For this there must be a co-operative credit society of brains with good financial backing up. The hub of the society must be a Public Health man who should be the friend, philosopher and

guide. He being the most educated man and having an insight into the human ills and welfare may be the cortex controlling the whole of the machinery. This Public Health Officer must be trained in the following subjects—rural hygiene, mental hygiene, school hygiene and St. John Ambulance work (advanced type in its practical application).

It is my experience that the fundamentals of all aspects of medicine and surgery have been well brought out in essence in the small books of the St. John Ambulance Association, called "The First Aid to the Injured" and "Home Nursing." The basic knowledge contained in these books can be taught to the public to avoid calamities. It is the first right step in the direction of medical relief. The Public Health Officer must be a person interested in this aspect of medical relief. He should be able to improve the scope of public health activities by training people in St. John Ambulance work and to attend to the sick and the wounded and transport them to the nearest centre where proper treatment can be given. The post of the Rural Medical Practitioner as it exists at present is not satisfactory. He is ill equipped and has little knowledge of the practical aspects of dealing with emergencies and he finds his primary role is to dole out medicines. The Rural Medical Officer should be a preventive officer and not a curative one. It is unfortunate that in our country the popularity of an institution is judged by the number of outpatients and not by individual attention that we are able to pay to each patient. This necessarily swells the number of chronic cases that seek advice from day to day. This system should not be an index of efficiency of the institution. The yard stick of the measure of efficiency should not be by the large numbers of attendance and requires a changed angle of vision. It has been my experience that it is not possible for the admitting staff to see a large number of cases in a short space of 2½ hours. It would be necessary to gauge the efficiency of the medical officer not by the total number of outpatients he treats but by the attention he pays in reducing the number of chronic cases attending the institution by specific attention to certain diseases which are preventable by nature. The Public Health Officer being well acquainted with the field work of his department will exercise the necessary drive through his sanitary squad and organise a good medical relief. The villager is always grateful when he sees that he has been attended to with promptness and care during his illness and when epidemics are controlled in quick time or when he has sustained an injury he receives efficient first aid and is later transported to a surgical centre. Such news of good acts will spread like wild fire very quickly among the villagers and the medical relief becomes popular and effective and the objective of disseminating knowledge is gained.

Groups of villages must be tacked on to centres with facilities for treatment of surgical, medical

and midwifery cases. The taluk headquarters hospital will serve this purpose. A motor ambulance must be attached to this centre to be utilised on requisition for transporting patients from villages where there are roads and if after receiving the case the Medical Officer finds it difficult to treat, he must direct the case in the same ambulance to the *district headquarters hospital*. The Public Health Officer must be in charge of the taluk headquarters hospital. He must be trained in rural, town and school hygienics. If there are many schools more than one public health officer is necessary to assist the chief officer. He should be given the duties of teaching the students "Hygiene" by the Socratic method so successfully employed by Mr. BRAYNE in his village uplift. He should also train students in ambulance work. The woman Medical Officer, Health Visitor or attached nurses should serve as teachers in Home Nursing to the girl students in addition to their duties. To my mind the teaching of Hygiene, St. John Ambulance work, Red Cross and Home Nursing must be taught at the school level, and must be a compulsory part of the programme and if this is done the children when they grow up will know the value of hygiene and how to protect themselves when they are in difficulties or in danger. This is the best method of making people conscious of the evils of all medical ills and prevent them. Confucius, the Chinese scholar and statesman, has stated in his "Wisdom" that the best method of Government is Government by music and while enunciating this policy he has made remarkable reference to the following points. He has stated that—

- (1) if there are more policemen, there is no liberty;
- (2) if there are more soldiers in the country there is no peace; and
- (3) if there are more lawyers in the country, there is no justice.

I wish to add one more to the above and that is, if there are more dispensaries there is no health in the land. At least there must be one Public Health Officer wherever there is a school of 500 pupils. The Public Health Officer may act as the Director of the School systems at taluk levels because he is better educated than the average village school master. This is the cheapest way by which medical relief can be promulgated.

#### Ambulance Training for Medical Students

Every Taluk Headquarters and District Headquarters Hospital which are envisaged as secondary and District centres in the Bhole Committee's report should have specialists on their staff, more especially in traumatic surgery. It is worthy of note that there is no ambulance training given to medical students. It is well known that the correct



method of transport of patients and the correct methods of first aid to the injured are factors that help in reducing the loss of life and limb. In the scheme of medical education, I am sorry to observe, that this aspect of the training has been entirely neglected and this defect should be remedied. I suggest that the student may be given an insight into this aspect of training when he is learning anatomy and physiology and it will be a good step in the right direction to direct the attention of the medical student of preclinical period to traumatic surgery. This training must be made part of the college discipline. The teaching must be made more interesting by constantly bringing to their minds the fundamental principles of anatomy and physiology in relation to the traumatic and other conditions. Naturally, people who have had ambulance training will deal with traumatic conditions and emergencies efficiently in their practice and will probably become the nucleus of centres of ambulance organisation wherever they go. How often have I noted as an examiner that the medical student while he can talk on advanced aspects of surgery is unable to correctly adopt the method of first aid. One of the Brigade Officers (non-medical) of the IV District of the St. John Ambulance Organisation in Madras boldly asserted that in a competition the medical students will find it difficult to compete with the lay members of the Brigade in ambulance work. This statement appears to be genuine and real from the experience of the competitions and I see no reason why our medical students cannot come up to the level if in the earlier part of the medical training they had a sound ambulance training. The defect lies in our teaching.

#### Brief Historical Background of Surgery

The practice of surgery as an art dates from the pre-historic times. Past excavations at Ur throw very good light on the surgery of the time in the Summerian period. Recent excavations may throw more light about the surgical aspects during the same period.

The recent excavations in Egypt and the discovery of Papyri popularly known as Edwin Smith Papyrus and Papyrus Ebers throw more light on surgery as practised in Egypt between 2000 to 1000 B.C. In this period the Exorcist came first, the Physician second and the Surgeon third in popular estimation. It is possible that the type of surgery practised in Egypt was the same as in the Summerian period. So far as India was concerned there is definite evidence indicating the practice of this art in the *Rig Veda* (4000 B.C.) and in the *Atharva Veda* (1000 B.C.) and there is clear evidence of slight traces of experimental surgery which were soon destroyed by a luxuriant growth of charms and invocations. The Brahministic period taught that it was pollution to touch a human corpse and thus prevented any study of anatomy

and the student was shown how to make incisions on fruits and punctures on bladders. Scarifications were demonstrated upon stretched skins; venesection on lotus stalks; the opening of abscesses upon a lump of wax smeared over a piece of wood; bandaging on a clay figure and cauterising on a piece of meat; in spite of these, there were attempts at resuscitation of this art. Cupping and bleeding, operations for stones in the bladder, complicated plastic operations were practised and couching of cataract was done on a large scale. CHARAKA and SUSHRUTHA, were the classical savants of the Buddhist period. They are credited with operations on the intestines and with Rhinoplasty. The surgery they did was far in advance of the times and they were good exponents of surgical skill of that period and the instruments evolved by them compare favourably with modern instruments.

Foundations of scientific methods in western medicine were laid by the Hippocratic School and continued by the Roman School of which evidence is exhaustive in the museum at Naples. Surgical instruments designed for a variety of operations resemble the modern instruments.

The work of CELSUS (25 B.C. to 50 A.D.) and GALEN (130 to 200 A.D.) showed the part played by the Greek medicine in the Roman civilisation and this was continued by the Arabians. It was GALEN who severed the spinal cord in animals and did the first experimental observation. The first hospital was started in Baghdad. RHazes (850 to 923 A.D.), ALBUcASIS (936 to 1013 A.D.) and AVICENNA (980 to 1036 A.D.) were the illustrious men who brought glory to Arabic medicine and probably this gave birth to the *Unani* medicine the term *Unani* meaning "Greek".

The Japanese also followed the methods of China until about 1871 when they broke away from the old traditions and forged ahead and were soon in the van guard of surgical progress.

Surgeons found their profession widely separated from medicine and in the 12th century A.D. this art was practised only by a few. Even the Universities of the time grudgingly licensed the practitioners in the art of surgery and more often with a proviso attached "so long as he does not practise medicine."

Until the 19th century, the story of surgery which was practised by a few people remained obscure. Heavy mortality and painful procedures drove fear in the minds of the public. It was revolutionised by the bacteriological discoveries of PASTEUR and the practical utilisation of this knowledge by LORD LISTER. The discovery of anaesthesia further helped the progress of surgery.

The sudden upheavals of progress of this art and science synchronised with wars. In our own times we know the contributions to the advancement of



surgery as a result of two wars. Older generations operated only to save lives sacrificing limbs, later ones to discover the causes of disease and its complications and operated to save life and limb. It is hoped that the future surgeon will operate only on animals to find out the cause in order to prevent wide and unnecessary surgical procedures.

This retrospect of the evolution of surgery has been given to bring home that this advancement would not have occurred had people complacently said that all that was done in ancient medicine is final. It may not be out of place to state here that when LORD LISTER introduced his antiseptic methods in surgery, other surgeons of the day laughed at him and his methods and continued to operate, with oldest filthy coats reeking with smell of blood, with needles stuck on to the lapels of their coats with disastrous results and would not even have the courtesy to look into the ways which LISTER employed to solve the main scourge of surgical complications, viz., hospital gangrene.

It was only when continental surgeons practised and advertised the value of his methods, his compatriots began to hail LISTER as the saviour of mankind. More than 70 per cent of the cases operated upon died before the introduction of Listerian methods. This state of affairs however changed with the introduction of antiseptics by LISTER (1829 to 1912) and with improvements effected by surgeons who followed in his footsteps.

The introduction of anaesthesia also contributed in no small measure to the advance of surgery and to the reduction of mortality. In modern surgery, the aseptic concept which has completely replaced the antiseptic one has made it possible for surgery to extend its beneficent sway from the extremities to all other regions of the body. Nowadays every cavity or organ is fearlessly attacked by the surgeon's knife; the brain, the skull, the spine and the spinal cord, the eyes, the nose, the ears, the throat and the lungs which are the guardians of our life, are restored to the proper functions; the pleura is drained, parts of the diseased lobes of the lungs are removed; the thoracic cage is collapsed; the heart is sutured; the broken arteries and veins are anastomosed; the ovaries, the uterus and the prostate are removed, the stomachs are opened and excised; and the intestines are repaired, resected and anastomosed. Wide and successful operations are performed for cancer with relief and prolongation of life. The congenital of acquired deformities are restored to normality by plastic surgery and the cripple problem is being solved. Compound fractures are turned into simple ones, and refractory bones are wired, plated, grafted and pegged. Joints are opened, cleaned, reconstructed and transplanted and thereby limbs are saved. Lives are saved by the transfusion of blood, and the grafting of organs like the testes, the ovaries and the thyroid is no longer considered to be an impracticable proposition. It would be sheer waste of

time, money and effort to revive the old system of surgery.

### Suggested Scheme for Investigation of Indian Medicine

Reformation in Indian medicine should be first directed towards research in drugs and specifics for diseases which are freely advertised, so as to select the useful medicines and discard the useless ones. It is suggested that it would be necessary to have a central institute of research department attached to existing medical institutions.

In Madras, there is an indigenous school of medicine now being formed into a college, where students are trained to be practitioners in both western and eastern systems of medicine. The basic educational qualification of these students is not satisfactory to enable them to understand the ancillary sciences which are the foundations of the modern system of medicine.

In Madras, the alumni of the same school, engineered several strikes on the ground of insufficient teaching facilities afforded to the students. It becomes obvious that if an unbiased investigation is undertaken, the school which has been in existence for over 25 years has failed to build up the teaching standards even though adequate opportunities were provided to the school. This shows that there is something definitely defective in its organisation and the intrinsic worth of the type of medical education that has been adopted in this institution. The following scheme is recommended to rejuvenate the ancient medicine and bring it into line with modern trends, with the following staff for the research department.

(1) Well trained physician of a professorial standard in modern and scientific lines and very eminent in diagnosing diseases with a good knowledge of Sanskrit.

(2) Eminent indigenous physicians of various systems.

(3) A brilliant chemist with a team to bombard the molecule of certain drugs which are considered efficacious.

(4) A pharmacologist with leanings towards research.

It is well known that there are some specifics advertised freely but the composition and formulae are kept secret. There are also some unexplained aspects of control of metabolism by will power, Hata Yoga is an example. What would be a happy method is for the clinician trained in western standards to diagnose the disease. After diagnosis a series of cases should be handed over to the expert indigenous physician who has these specifics. The western trained clinician and the indigenous physician will maintain records correctly in their own way. The treatment should be carefully watched day to day, week to week and month

to month and impartial observations should be made on the progress, actuated by a pure motive of research without any ill feeling or animosity to any system of medicine under investigation. The western trained specialist must be a conscientious person prepared to say the truth even though it may not be palatable to the modern system or the indigenous system. It is unwise to waste our time, energy and money in adopting CHARKA and SUSHRUTHA technique in surgery to-day but it would be interesting to know in more detail what our ancients did. In progressive thinking a historical background gives a better perspective.

PANDIT NEHRU, GHAZNAFAR ALI KHAN and Dr. T. S. S. RAJAN have stated that it is necessary to review the ancient medicine in the light of modern scientific knowledge—a view held by all scientifically minded people. Clear thinking is necessary and the aim of the politicians and medical men should be to build up medicine suited to our conditions not by manufacturing different kinds of practitioners but by building up a synthesis of all aspects of medicine into one. What is good in the past, can be added to the existing knowledge. It would be a great day when a research institution of this type is started to delve deep and unearth the truths of our ancient medicine. Such a research institution will necessarily attract all types of men interested in medical relief and the scientifically proved indigenous system of medicine would be raised to the status of scientific medicine and thus it would come into line with modern trends in medicine. Such a synthesis would be an ideal to be aimed at. It must be the aim not to manufacture more ill qualified practitioners and let them loose on the public.

Everybody is eager that we should send medical relief to the villages. It is unfortunate that when the question of medical relief to the villages is being considered we are prepared to send all types of men without a sound medical education. We may ask ourselves, "Why should we send such ill qualified men? How are the lives of the villagers cheaper than those living in the cities and urban areas?" It is all the more necessary to send efficient men to the villages than to the cities or the urban areas. In the urban areas and cities the practitioners have the benefit of surgeons and specialists to guide them. In villages, they have no such guidance and therefore it is quite necessary to send trained men to the villages. To send inadequately trained doctors would not only be suicidal if it is the objective to wean the villagers from quacks, but in the long run would create a serious problem for any future Government to solve.

#### Medical Education

It would not be out of place here to discuss medical education in general and surgery in particular. We all realise that there is some inherent

defect in the present system requiring a lot of re-orientation and re-adjustment according to modern trends. Every teacher in medicine is aware that the curriculum is both heavy and in some cases unworkable. With the advent of specialities it has become more difficult to adjust the work of the basic medical student. It must be the outlook that we must take into account the ideal in spite of its past development, with the changing social and economic and scientific conditions of the present and the future. I have already shown the evolution of medicine in general, its trials, tribulations, successes and failures of the past, and it is but right that we should concern ourselves with the improvement of the conditions that exist at present with an eye for the future.

India had a glorious past in medicine. The western methods of medical education which are now accepted as the scientific system were implanted on our soil by the East India Company Government. The sole object of starting this medical education was to develop a subordinate staff to help the protagonists of these sciences to carry on their work smoothly. The outlook of all the people who had the benefit of this education has been changing. In recent times as in our aspirations for political independence, there has been a definite trend to improve medical education and medical relief. Various societies have been founded to better the medical standards of education and thought and such a move was taken by the Surgeons in the formation of the Association of Surgeons of India and it is but natural that we should review our past standards, critically review the present system and propose improvements for the future. The present system, thanks to the independence of the country, will have to adjust itself to the altered conditions and the medical profession should educate the public to cure this split mind that exists in medicine. There are no two opinions about medical relief. Though all medicine is one, the methods of approach towards the attainment of its perfection are varied and it is but right that in this age of ours we should synthesise our medicine and bring it into line with scientific trends. The system of medical education is being brought to a uniform standard and a research outlook is taking hold of the younger generation fired with the ambition to keep abreast of the outside world. With the awakening of the political consciousness the Government must give a momentum to advancement. It is but right that we should point out to the National Government that we are one with them in the attainment of independent ideals as much in the field of medicine as in others and the objective can be gained by researches into the past, stabilisation of the present, in our medical education this aspect has been entirely ignored and for reasons well known there is a gulf of difference between the ancient and modern medicine, modern ones knowing nothing about the ancient and the ancient medi-

one knowing nothing about the modern. Is it not time that we should bridge this gulf and have a really scientific approach with researches in this aspect of medicine? Researches not based on ancillary sciences would be defective and barren. The first essential that we have to foster is a research department in the collegiate institution or start entirely self contained research institutions for this purpose and not start imperfect colleges of indigenous medicine producing graduates or licentiates to practise. *Sentiment should not outweigh reason and later be faced with a problem of caste which would be difficult to get rid of.*

We have only to refer to the valuable information given by the Bhole Committee which has tried to collect this in the shortest space of time. The existing scheme of medical relief has been carefully scrutinised and a plan set out for the future. If the Province should adopt this excellent direction with suitable alterations to suit local conditions, the future of medical relief would be put on a very sound basis.

It must be well within the knowledge of every teacher in the college that the majority of the students in the colleges are satisfied only with snap shot impressions of cases seen by them. During their junior clerkships, the main defect in education is the lack of liaison between the professor and the taught with the result that the students get a variety of ideas pumped into their exhausted heads and sometimes in the same institution different and diametrically opposite views are stressed and pumped into their minds. These are not based on researches or experience gained by follow-up of cases but gathered from thoughts of other men with the result that the students suffer from split minds in medicine. They begin to wonder whether what they are seeing is really useful. If an unbiased investigation is made we will find that there is no co-ordination of teaching work from the start to the finish. Anatomy is taught for the sake of anatomy and not with the objective that it is useful for the student in his future study. After the examination in anatomy, the student safely forgets the fundamentals of anatomy. Where then is the defect? Similarly with regard to other ancillary sciences. The defect is both in the teacher and the taught. The selection of candidates for teaching is not ideal and probably you will all realise as I have that it is too much to expect that a student who has been brought up from his infancy in conditions of life and thought grooved into a definite channel, to suddenly change his trend of thought. The whole system of education must be looked into. It is distressing to realise however that many elementary schools, high schools and college limit their studies to a mere passing of the examinations. No independent thought is cultivated. The children accept such training with little question and in India the general knowledge of a student is so colossally poor that it is no wonder that he has not pro-

gressed to the required extent. Introversion is the main drawback of an intelligent child in India. We have been brought up in this way but with the changed outlook let us hope that the child will be an extrovert, more interested in doing things and becoming effective in what he decides to do than in himself.

It has impressed me profoundly that by observation of my school mates, college mates and children and my own children that most children make excellent beginnings, but as some of them advance through school, their curiosity and imagination gradually become blunted. They may go to professional college some of them lack a genuine vital and compelling interest in what they are studying. Their attitudes are passive rather than active and their success is chiefly due to their good memory. This seems incredible and in every college, there are many students under the present systems of qualification for promotion who meet with the requirements of degrees but who have lost that fresh and insatiable curiosity and imagination with which they started out in life. It should be the mission of education at every level to stimulate and constantly nurse the curiosity and imagination. With this outlook, education can be fruitful; otherwise it would be barren.

Progress in medical education and science depends upon the students' freshness to retain the vital impulses of curiosity and imagination throughout their lives. There is good reason to suppose that some of the present methods of formal education blunt rather than sharpen these essential qualities and I do hope that the National Government's policy will be to correct this defect.

It would be an eye opener if we take an actuarial study of all students who enter the portals of a college for a study of their career, the financial embarrassments the student suffers from, the environmental conditions influencing their career. This study may tell us where the defect lies. The selection of teachers is far from ideal, and the number of teachers for training the students is also far from adequate.

A hungry mind is anxious to learn but a hungry stomach prevents it from attaining this object. In spite of this we must admit that the student population has done its best and it must be our objective to better their standards and aspirations. Any sound plan of medical education must embrace the entire educational experience from childhood to retirement from practice. It is essential to develop a comprehensive programme of health education for everybody, to broaden and deepen the cultural and scientific education of the college students, to adopt broader principles of preventive and social medicine in the programme of medical schools to co-ordinate and unify the whole educational process. This will produce doctors fully capable of assuming the obligations of responsible

citizens and of exercising leadership in solving problems of individual and community health.

The course of study in the medical colleges is prolonged and probably the students' minds are over burdened with facts more often without a practical bias. How often do we find in the class rooms and wards the blackboards are being frequently used for teaching purposes instead of studying the patients and observing and inferring from cases that are in front of them? This aspect necessarily leads the student to feel that it is not the cases that he has to study but it is the lore that is contained in the books and thus he ignores the ward work and concentrates his attention on the written words in books. I am sure a stabilised National Government will look into this question in more detail and more carefully into the aspects of not only medical education but education in general.

Thanks to the initiative of the present Minister of Public Health in Madras, the Hon'ble Mr. A. B. SHERRY, a conference of all shades of medical opinion was called by him and a special committee has been constituted to advise him on various aspects of medical and public health relief. Such a scheme may bear fruit if the Government accept the propositions put forward with a good financial backing up.

### Specialisation in Surgery

It would not be out of place for me to say something about specialisation. The general surgeon has held the field for a long time and is still holding it. Specialists have developed in certain lines in big cities where colleges exist and more specialists are demanded by the public in the mofussil areas. The development of specialists in surgery is entirely due to the General Surgeon's concentrated interest in a particular field of thought and this becomes quite plain in tracing the evolution of specialisation. It is after the training as a general surgeon he directs his attention to narrower spheres of activity for developing technical skill and for gaining wider and deeper knowledge of the narrow field. No doctor should undertake speciality unless he has had a foundation in general surgery apprenticeship to senior surgeons well versed in this art and science. Later he must divert his attention to a speciality. A perfunctory knowledge would not only be fruitless but criminal. It is within common knowledge that the practitioners in their struggle for existence finding it more difficult to make a living, resort to some specialities hoping that they may eke out an existence better than their neighbours but with what consequences it is easy to understand. Surgery is a hard mistress and unless we have a programme of study and apprenticeship surgery will not advance and at the same time will be a menace to public safety. Everyone of us must have come across the ill results of a general practitioner taking to surgery without his proper apprenticeship. The approach

to this problem should be to encourage the post-graduates who have definite leaning towards general surgery and specialities so that they may flower into surgeons and specialists. Their services should be utilised in the remoter parts of the country. Specialities in surgery have become so many that differentiation is going on apace in other countries though halting and slow in our country.

At present it is a notorious fact that even in the majority of district headquarters hospitals there are no qualified surgeons on the staff of the hospitals. The District Medical Officer is a general practitioner and sometimes shows a leaning towards surgery but without any foundation. It must be the aim of the Surgeons' Association to impress that the future surgical centres must have trained surgeons on the staff in the remotest parts of the country.

In the furtherance of this objective all clinical institutions must concentrate on the training of their assistant surgeons as surgeons and specialists. I have as a teacher three assistants and 3 post-graduates but have only one theatre available for 3 days in the week for operations. It is necessary to have a theatre system attached to each unit so that these may be made available on all the days of the week. Three days can be used for the operations and the other three days for special types of investigations and junior surgery. Everyone knows the time taken for special investigations with modern instruments such as Gastroscope, Cystoscope, Arthroscope, Peritoneoscope, Endoscope and every other special gadget. In the furtherance of this objective, the younger men must be given full facilities to use these instruments on a large scale for more efficient diagnosis and once they become adepts in the use of these special gadgets, their minds will necessarily be directed to special channels. Stimulated by the interest that he has taken in the use of a Gastroscope that person will necessarily be a Gastro-enterologist and a man who does cystoscopy on a large scale will turn out to be an Urologist. Once a junior has made his mark in the use of these instruments, the Professor will necessarily give more and more work to such a person who is worthy of his confidence. This is the real way to develop specialities and the aim of the Professor should be to direct the young men's attention in special channels and inspire them to do better work than he himself has done.

I agree with DEEVER who said about a Professor's qualifications "If he is the practical and efficient personality which he should be, he will certainly possess the proper sense of the value of team work among his staff. Imbued with the importance of training his young assistants in self reliance and independence of action he will delegate to them the daily routine and the less intricate problems of diagnosis and treatment. The

service of the master himself should be required only for supervision and consultation in the more unusual and serious cases. In this team work there also enters the interplay of art and science." The aim of a good teacher has been from time immemorial to produce his successors. When teachers forget this responsibility there will be stagnation. It happened in India in the past and should not happen again.

### Operation Theatres

It would not be out of place for me to say something about operation theatres and their construction as this has a bearing on the training of the future specialists. I hope I am voicing the feelings of all surgeons when I say that we are dissatisfied with the operation theatres as existing at present where we have to spend the most strenuous part of our lives. Apart from the inconvenience of humidity and various other factors, the number of theatres at the disposal of each surgeon is too inadequate especially in teaching institutions. The Surgeon has necessarily to work long hours as each operation takes time and the volume of work for each surgeon in these institutions is great as the admissions cannot be controlled and the staff is inadequate to cope with the work.

A lot of time is at present being wasted in between operations. The students crowd round the place fouling the atmosphere, with no proper arrangements for their accommodation and in a tropical climate working with closed doors and sterilisers working in the adjacent rooms, the temperature of the operating room necessarily increases and saps the life of the surgeon and is also one of the causes for adding to the dangers of severe operative procedures. It is necessary that the surgeons should discuss about the place of their activities and evolve a scheme. Firstly each surgeon must have a theatre system to suit him and it is my view that twin operation theatres with all the equipment and staff should be permanently attached. The theatre staff should not change and should be a unit by itself so that in a teaching institution the unit by working harmoniously will help the research outlook in surgery. At present, the theatres are inadequate, ill-ventilated, ill-lighted and ill-supplied with instruments and ill-staffed. A changed outlook is necessary. The dream of future theatres is to prevent overcrowding and this may be secured by the installation of teleprojectors to project the operations outside the theatre for the benefit of the students.

### The Theatre Nurse

The training of theatre nurse is a very important problem and more so in India. Our methods of treatments in surgery are changing from time to time. Newer techniques replace the old. More and more delicate instruments and gadgets are introduced in surgery. Accidents are due to care-

lessness on the part of the nurses and the other staff. Unless the question of nurses' training is taken into consideration it would be impossible to carry out all the advanced aspects of treatment. The theatre nurse is a very important part of the unit and how often in hospitals have you not found that the theatre nurses were not up to the mark and are a source of headache. But it must be said to the credit of some of the theatre nurses that once they undertook the theatre nurses' job they undertook the work wholeheartedly for the love of it. Sometimes the work is forced on them with the result that the work is badly done and it becomes the serious anxiety of the surgeon who is unable to rectify it because he is subject to administrative vagaries. It is essential that the theatre nurses should have a post-graduate training centre in theatre work and they must be specially selected. These nurses must be put on a better footing and emoluments than the ordinary nurses and must not be changed very often as it is being done now. The nurses should take an abiding interest in all the latest information about theatres and their management and it is the duty of the surgeon to impart to her the knowledge about the modern aspects of the operations, techniques and the apparatus used. I have found that if this scheme is adopted, not only does she take an interest in the cases but also takes care of the surgical appliances and valuable instruments which we have to handle thus increasing their longevity.

Anaesthesia has become a specialist department and I am glad to hear that an Anaesthetists' Association is to be formed to further their interests and I as one who started life as an anaesthetist in a general teaching hospital fully sympathise with their interests. The success of an operation and the smooth post-operative course depends upon a smooth and well planned anaesthesia as well as the skill of the surgeon. The status of the anaesthetists in our country is not honourable. They are ill paid and it is my opinion that they deserve better consideration. I think it is time we surgeons give up our superiority complex and consider them as responsible partners in our undertakings.

### Cancer Problem

The treatment of cancer has developed into a speciality. The outlook of a surgeon in this direction has also to change with modern trends in medicine. With the development of the knowledge of the subject one knows how difficult it is to manage this aspect of treatment and necessarily therefore we have to divide our work between radio-therapist, radiologist and the surgeon. The starting of the Radiological Association is of happy augury. Let us hope that the treatment of cancer which is imperfect due to the ignorance of the public and of the doctor and the difficulties the general surgeon has while tackling this problem may be put on a sounder basis by a co-ordinated

effort by all concerned in the war against this terrible disease. The magnitude of the problem of cancer in India is not quite obvious as authoritative and recorded evidence is meagre. It is therefore not possible to develop centres for diagnosis and treatment of cancer. It is essential that there should be a scheme for recording cases of cancer in each hospital, to diagnose it clinically and pathologically and maintain a register specially for this purpose. Most of the cancer cases are not admitted and are generally seen as outpatients as the majority of them are beyond all hopes of cure. If these cases are not recorded in a proper register it would not be possible to assess the incidence of cancer in any particular area. Such a scheme was put into operation by me personally with the result that I have been able to gather very valuable information with regard to certain aspects of cancer. This should be enforced in all hospitals and a regular scheme of recording thought about and instructions issued to all the hospitals to submit annual returns in a model form that has to be evolved. If this is done, it would be possible to assess the incidence of cancer and devise methods to treat this condition. It is essential then that we should have a cancer and sarcoma register enforced by legislation for each presidency which will be a compilation of the returns sent to the Surgeon-General. These statistical records will be invaluable for research as well as to devise methods for the treatment of this condition.

### Industrial Medicine

It would not be out of place to talk about industrial medicine as this may prove useful in solving some of the morbidity in industrial concerns.

In India there is no definite organisation with regard to medical relief in industrial concerns except that certain companies have gone out of the way to have their own medical arrangements. The development of an industrial physician who will be dealing with both medical and surgical diseases should be instituted by the National Government as labour, which is getting very restive, demands several rights without the duties attached to it and sometimes industry is handicapped on account of sudden absenteeism on flimsy medical grounds. It is necessary that industrial concerns should have doctors to supervise the health and physical condition of their employees when they are on their jobs, to examine them before employment, to prevent and control infectious diseases in the plant, to recognise occupational diseases and advise on their prevention, to treat plant injuries and occupational diseases and to inspect the plant and general sanitation, to study the plant processes and hazards so that they make recommendations for preventing disease. This comprehensive scheme must be enforced and medical men employed. In the long run it would be a great help to industry in preventing morbidity by attention to occupational and industrial injuries. The present arrangement of

attention of industrial injuries is imperfect and uneconomical and the treatment adopted for these injuries is definitely unsatisfactory. Obsolete methods are being emphasised even to-day and the low standard of surgical work that is done does not redound to the credit of the medical profession and the increase in the morbidity and compensation shows that something has to be done to devise means for curing this defect.

In educational institutions, the medical students in their courses of preventive medicine do not get an inkling of industrial medicine. It is essential that we should make a beginning in each teaching institution by having a medical officer who will form a liaison service between the industrial concerns who send their patients to the hospital and the hospital authorities. He will visit these various industries and will be on their panel for advice and treatment and also be on the staff of the hospital. With the knowledge gained he will be a valuable teacher to the medical students. Six demonstration talks on industrial medicine during their course of preventive medicine would be invaluable in the training of the medical student. This should not be a black-board demonstration and set lectures but should be clinical demonstrations with a limited number of talks on industrial medicine.

### The Role of the Pathologist in Surgical Teaching

In the whole scheme of medical study, in the development of post-graduate teaching and for research, the position of the pathologist must be clearly defined. I am afraid the progress in the achievement of technical skill in specialities has been slow. Though various causes are responsible for this, yet one of the main and important cause is that there is no co-ordination between the pathologist and the various other units to understand and interpret disease and investigate the failures after intensely technical operative procedures. Such a scheme of things has not been existent in the majority of the clinical institutions with the result that the relation between the pathologist and the surgeon has been only through paper transactions. If we want to make any mark in our progress, it is essential that the pathologist should be our guide, philosopher and friend and a merciless but fair critic without the poisonous fangs. This will help the advancement of surgery and at the same time add to the academic knowledge. Otherwise our technical skill will be merely devoted to bread-winning pursuits. It is essential that we should have for each clinical institution a pathologist of eminence to guide us in all our fields of work. It is also essential that the various units should give the necessary facilities and respect for the opinion of the pathologist to enable him to rise to the eminence he has to attain. Such a scheme of things will be twice blessed; it will bless the pathologist to get to know the clinical units in understanding the disease, and also the surgeon of



the unit to interpret the disease in the light of the knowledge given to him by the pathologist from a critical survey of the specimens removed and from the post-mortem findings of the operative procedures he had performed. I have benefitted immensely by such contact, which alas, have in recent times been less frequent since I had to attend to the administrative function of the hospital. The staff of the pathologist is so meagre and the strain we put on these is so great that often there has been friction between the two departments but we have not come together to solve the trouble by jointly putting forward concrete proposals to augment the staff. I know that even when proposals are put forward they are not considered but we must be persistent in our demands when we are sure of our aim in the scheme of teaching. There is always a reaction to any suggested improvement. I was told by my esteemed friend Dr. KHANOLKAR, a pathologist of eminence in our country, that one of the former Surgeon-Generals told him plainly that it is no use wasting one's time in research, because it is being done elsewhere. No wonder that we have not made any progress in spite of the wealth of material that is available but not utilised. A scrutiny and heart searching will tell us the true tale. Is it possible to get a move on? With a National Government to back up, it should be possible to forge new schemes of vital interest in medicine such as manufacture of drugs and appliances, assessment of ancient medicine, investigation of diseases which require solution by research, development of post-graduate teaching and provision of facilities in our country up to the standards obtainable elsewhere. At one time it was estimated that 3 million pounds was spent annually by the Indian students to get theoretical training in western countries. If parents could pool these resources and if all the facilities are provided here it would not only enrich our country with knowledge but also will give us self respect. When will the day dawn? Let us not wait for it but struggle to see it soon.

#### Technicians

I wish to make the following observations which arose out of the difficulties I encountered while doing clinical research. It is essential for conducting clinical research that the records must be complete with all the necessary information. Students usually like to hear their Professors but do not like to make their own observations and record them on the case sheets, with the result that the case sheets are grossly deficient in the recording of necessary information. For this inadequacy there are three causes:—

1. Inadequate mental equipment of the junior assistants to guide the students in the observation, inference and recording of the fundamental signs and symptoms of diseases.

2. Lack of responsibility of the medical student to work without supervision. Lack of adequate

supervision due to insufficient staff gives him the latitude to write a few notes to throw dust into the eyes of the Professor, with the result that the post-graduate student is handicapped by the inadequate information in the case sheets. This is a very great handicap for clinical research.

3. There is another factor. Correct recording of reports of the special investigation is not made easily available due to various difficulties and from my talks with the pathologist, bacteriologist and the biochemist I have gathered that it is not possible for them to do this with the staff at their disposal. Therefore there is a lacuna in the clinical recording of the case sheets, due to want of regular and timely service between the different departments on the one hand and the clinical departments on the other.

Having been an assistant Professor for 7 years and a Professor for over 15 years and having worked as a Superintendent of a General Hospital for over six years and having attempted to do clinical research I have become more than ever convinced of this void. I therefore consider it necessary to have a liaison service between these departments.

The acme of perfection of a clinical institution should be to provide immediate and proper medical or surgical treatments, with a bias for scientific investigation. It is quite possible to afford the necessary treatment on a clinical diagnosis but in a teaching institution, the scientific bias should be a predominating feature, e.g. if an acute abdomen is admitted for an inflammatory condition, it is necessary to investigate the blood picture immediately and having opened the abdomen, it is necessary to know the type of causative organisms by cultural methods to complete the records for future study. Examples of this sort can be multiplied. The teacher of medicine is peculiarly confronted with lack of information of this sort when he wishes to talk to the students or post-graduates from his vast clinical experience. Hence he has necessarily to depend on information gathered from books or journals. The ideal of pathological service should be to provide facilities for collection of pathological specimens from the operation theatres and also for preparing frozen sections and furnish immediate reports so that surgeons may be enabled to carry out the necessary treatment especially with regard to certain type of tumours. At present, the pathological specimens are collected at the end of the day and sent through one of the toties or lascar to the bacteriology department and sometimes the surgeon finds that the laboratory is closed and the specimens are returned back. Sometimes the menial servants without knowing the value of the specimens, mix them up or lose some essential tissue which is vital for a diagnosis. To prevent such contingencies a new system has to be evolved by providing a liaison service between the clinicians, the pathology and the bac-

teriology departments. Though it may not be possible to reach the ideal, I venture to suggest that a step forward can be attempted if trained technicians working under the bacteriology and pathology departments are attached to the Hospital, so that one man is always on liason service between pathology and bacteriological departments for each clinical unit if possible.

*What the Technicians will have to do is set out in detail below :*

**I. Bacteriology Department :—**The most important duty of the technicians of this department will be to assist the physicians and surgeons by providing the necessary material for cultural investigations. Under the direction of the bacteriologist, they have to transport the proper requirements of culture tubes and other materials for the clinical investigation of cases of medical officers. As it is necessary to carry out intelligent study to meet the requirements of the medical officers, there must be a man with a superior standard of knowledge of Chemistry and Biochemistry. The technicians for clinical institutions should be those possessing qualifications in Chemistry to take an intelligent interest in the work and not to work mechanically as it is done at present. There is inordinate delay and several investigations cannot be done for want of sufficient liason service between the bacteriological department and the clinical departments of general hospitals. For want of sufficient operation theatres, it is not possible to do septic cases except after completely dealing with the aseptic cases. These cases usually are done at the fag end of the day's work. This has been going on for a long time and requires re-adjustment and reformation. Building more operation theatres will speed up the work but cannot be given effect to for a long time to come due to the present prevailing conditions. When specimens are sent from the septic cases to the bacteriological laboratory, some of the causative organisms die during transit due to atmospheric conditions. Sometimes the department is found closed with the result that no bacteriological investigations can be done. As more emergencies occur at night it is more essential to have a staff for emergencies. Cases of Diphtheria, coccal infections acute inflammatory conditions of abdomen and similar acute conditions are attended to at night and the bacteriological picture is often lost. The patient is treated without scientific advantage to the clinician, to interpret the true pathology caused by the organisms that produced the disease. It is for this purpose that there should be technicians to work by day and by night and always available in the clinical laboratory attached to the hospital. If this is done, it will help the teacher and the taught to get the necessary inspiration from their own records.

**II. Pathology Department :—**This technician will serve as a liason service between this department and the clinicians and will work in the pathology laboratory and should be able to examine blood smears, do clinical pathology and help in cutting

sections, in the temporary mounting of specimens taken by day and night, take down complete notes, transport them to the pathology department and obtain reports from there, and record them in the case sheets of the respective patients.

Paucity of beds affords a problem on the admission days of each Physicians or Surgeon. Sometimes cases which are of clinical interest have to be discharged to admit emergencies which are plentiful and thus we sacrifice valuable clinical material useful for instructional purposes so as to make room for acute cases. There are no annexe hospitals to transfer the chronic cases, attached to any of the clinical institutions. Overcrowding is a feature of general hospital where cases are admitted as they come.

There is no system of a waiting list as in British Isles regulating admissions. In Madras, patients from all parts of the Presidency seek admission when they find that the local treatment has not benefited them. Some of them are so poor and illiterate that it becomes an imperative necessity to admit them. This necessarily leads to overcrowding and has been a great strain on the medical and nursing staff and the resources of the hospital. Quick admissions and quick discharges are the rule, and the special reports are received after the discharge of the cases when the case sheets have been sent to the registration department. Special effort has to be made to enter the reports in the case sheets after calling for them from the registration department. But this is never being done as it involves time and special effort on the part of the medical officers who are already overworked. It also increases the work of the registration department which is poorly staffed and has to see that the case sheets that are sent to the departments are returned back. Sometimes the case sheets are lost. To avoid such a contingency, it is better to have a liason service and the technicians are the ideal persons for this purpose. In Great Britain and in America, technicians play an important role in the research departments and some of them have done very clever experiments and helped in bettering investigations. If it is the object in future to equip the institutions for post-graduate teaching, then I venture to suggest that it is desirable to have this scheme so as to enable the teachers to be conversant with their own clinical material and with the pathological details, instead of having to depend entirely upon thoughts gathered from books and journals. This type of teaching will be appreciated by the post-graduate students. To improve the scope of the post-graduate teaching as well as junior teaching for undergraduates, technical assistants should form a very important link and if their services are properly utilised they will be a great asset not only in the treatment of cases but also in the recording and interpretation of diseases.

I wish to make it clear that though the technicians will not be able to give the necessary reports immediately by night—as the reports have neces-



sarily to be given by a qualified doctor—at least instead of having to wait for a long time, the technicians will facilitate their early production. As it is, there is a great delay in the production of these reports. It will always be an advantage to the staff of the respective departments who are working shorthanded to have these technicians who will do the work pertaining to the hospital clinical units and will be responsible to them concerning the materials taken to and from the hospital. They will also be able to supply the necessary details of information which are so often perfunctory and lacking. The specimens at present which adorn the racks are blank without clinical or operation findings. What a technician can do can be illustrated by giving a simple example of a practical case. A case of cyst of the abdomen, subumbilical region, is operated upon in a child aged 2 years. This proves to be a congenital hydronephrosis. It is removed. This case requires the following attention by the technician.

(1) Examination of the fluid.

(2) Mounting of the specimen removed in the natural way it was found at the operation by distending it with formal saline solution to conform to the size found at operation.

(3) Take clinical notes as well as operation notes of the case carefully and help the pathologist and the clinician in mounting the specimen and place it in the museum.

(4) Help in section cutting, indexing, writing of the notes, transferring the notes from the hospital case sheets to the pathology department.

I can multiply such instances to show that such a system is not available at present. The pathology museum abounds in a number of specimens and in the majority of cases there is no data or clinical notes or histological appearances classified and indexed in the way it should be done and as it is done in their foreign countries and Universities, with the result that they are not of any academic or scientific interest from a teaching point of view. Though these specimens might adorn the racks, to my mind they are not helpful for investigations and reminds me of a second-hand book-shop. Valuable books may be there but they require painstaking selection.

As no medical man will be willing to do the work on the play and emoluments existing at present under the present conditions and as he will be more anxious to supplement his income by private practice, his interest in the work will not be so wholehearted and therefore I suggest that non-medical graduates be employed for this type of work.

A selection may be made from among the graduates with science subjects and these persons may be trained in special institutes, or pathological, biochemical and bacteriological departments of teaching institutions. They may be given a diploma at the end of the training and posted to the respective departments according to their diplomas, so

that they form one of the most important links in the chain of organisation for scientific investigations.

No research, whether clinical or basic, is possible without well-trained technicians, and I consider this is a vital factor in the whole scheme. Medical men who come as post-graduates come and go but the technicians should be the stand-by for the institutions for helping in the basic and post-graduate training of the medical student.

These personal observations are recorded to show how clinical research is handicapped at every stage with the result that for the volume of the clinical material that is available in India, the poverty of the clinical papers published stand out in relief and in my opinion is due to the operation of the several defects pointed out above. A young man who has a strong desire to do research when he finds difficulties at every step gives up the ghost and takes the path of least resistance.

### Research

Research is in the air. Everybody talks of research. Medical institutions have existed for 100 years and over but the research papers that have emanated from these centres are very few. Basic researches were carried on hill tops. When anyone thinks of research, it is always in terms of basic and ancillary sciences. I therefore wish to emphasise that clinical medicine should also be considered as a subject for research. I am glad the Indian Research Fund Association has stimulated interest in this direction. The Provincial Governments also will have to encourage research. In clinical institutions experimental research is very neglected. How often do we find nutrition being taught on the blackboards with no experimental or clinical data.

Our pathological museums are replete with specimens of various types in the advanced stage of the disease and the student is not able to appreciate the various changes that take place stage by stage in the organism from the start. Demonstration of specimens in the various stages of development of disease so as to enable the students to visualise the changes that ultimately lead to the destruction and failure of function with consequent damage to human organism is quite essential. It is hoped that in the future we will have experimental surgery and experimental medicine as active parts of a pathological laboratory where the under-graduates and the post-graduates will work and see for themselves the day to day changes that occur in the organism as a result of disease. Clinical research should go side by side with basic research. It is a well-known fact that many of the clinical institutions are grossly ill equipped with statistical records for post-graduates to study and carry out clinical research. It is time that we concentrate our attention on this aspect of records.

The guiding aim of research should be as enunciated by FRANCIS BACON :

"The patience to doubt  
 Fondness to meditate  
 Slowness to assert  
 Readiness to reconsider  
 Carefulness to dispose and set in order and  
 hating every kind of imposture."

### Appeal for a Post Graduate College

SIR HAROLD STILES when he went to Philadelphia in October 1921, speaking on the need of co-operative thought in surgery said before the American College of Surgeons—"The possibilities which your college affords for organisation and prosecuting a systematic investigation not only into immediate and end results of operation but also into the value of various other measures employed in surgical therapeutics are very great. With the machinery for organisation which your college possesses, the untold wealth of material at its disposal, and the reliable observations which could be guaranteed, I am convinced that America would again lead the world. Science is ever becoming more and more international. America has taken more advantage of this cosmopolitan spirit than we Britishers and in my judgment this is the main reason why the sceptre of surgery is to-day wielded by America."

If he had made this statement in 1921, it is more true to-day as we have learnt through our contacts with the various American hospitals in India during the war the perfect system that they have developed and the spirit of investigation even on the field. Such a system is worthy of emulation in our country and should be the ideal to be followed. America is leading the world in manufacture of drugs, appliances, medical education, and research. In surgery, it has become a place of pilgrimage. It used to be Vienna formerly. All the savants and skilful exponents of this art and science are centred in this country.

The material in India is extensive. There is no lack of intelligence. What is required is effort on the part of the surgeon and encouragement by the State and philanthropic individuals.

It is my earnest hope that some moneyed men may come forward as donors and start a post-graduate college. Bombay gave birth to our Association of Surgeons of India. Is it a mere dream to hope that Bombay may start the first post-graduate college and an efficient college of surgeons—Bombay, such a magnificent city with millionaires and multi-millionaires who, on many past occasions, have shown by their generosity that their outlook in life is not only to make money and make themselves happy but also to radiate happiness to those unfortunate people who are placed in poor circumstances. No better service, can be done to humanity than by starting such a post-graduate college for research and teaching which will make men efficient in the service of the public. As a result of this, may it be said that India in its age of independence is thinking aright and the public, the politician, the merchant, the land-owner, the millionaire, the scientist and the doctor have worked together for the common cause of further-

ing the interests of the Indian Nation so as to enable her to find a place among the nations of the world.

After the inauguration, the usual group photograph of the members of the Association was taken.

The first Governing Body Meeting was held at the Physiology Lecture Theatre of the J. J. Hospital at 11 A.M., Dr. M. G. Kini presiding. 15 members were present.

Minutes of the last two Governing Body Meetings were read and passed. About 30 new members proposed during the year were duly admitted.

There was only one entry for the Prize Essay on "Surgical Aspects of Amoebiasis", and since the essay was not up to the standard, the Prize was not awarded. In view of the poor response from the profession, it was decided to drop the Prize Essay competition from 1948 onwards.

Discussion on the three main subjects, viz., (1) Bone Tumours, (2) Spinal Tumours and (3) Burns, fixed for the year were held in the afternoons of the 26th, 27th, and 28th December respectively.

The members visited the K. E. M. Hospital, J. J. Hospital, Tata Memorial Hospital and Wadia Children's Hospital, and had the pleasure of seeing Surgeons at work. Operations for Spinal tumour, Carcinoma of the Stomach, Adenoma of the Thyroid and Renal Calculus, etc., were among those witnessed.

A boat trip round the Harbour was arranged and every one thoroughly enjoyed the trip. The weather was ideal and every one was kept lively and entertained, thanks mostly to the efforts of young Vasant P. Mehta. The absence of the Annual Dinner was keenly felt, but this was unavoidable on account of the Food Control. There was, however, a Cocktail Party, which was well-attended and was a great success.

There were a few functions common to all the Associations and among them, a reception at the Harikishindas Hospital. This is a private Hospital and its size and equipment speak well for the Philanthropy of the rich men of Bombay.

A Meeting of the Editorial Board was held at the Tata Memorial Hospital on 28th December at 11 A.M., Col. Pandalai, the Chairman of the Editorial Board, presiding, and methods for improving the standard of the journal were discussed. The Meeting adjourned to 30th December at 10 A.M. for considering reconstitution of the Editorial Board.

It was decided at the Meeting that in future each member of the Board should procure at least two articles every year from his area and if he has not procured any article for two years consecutively, his name would be taken away from the list. Members would, in the first instance, see that the articles sent in were of the required standard. A Section devoted to periodic progress in different branches of Surgery was to be included in the Journal and for this purpose, every member of the Board should be requested to take up some branch of Surgery and review the periodical progress.

### The Annual General Body Meeting

The IX General Body Meeting of the Association of Surgeons of India was held on 29th December 1947 at the J. J. Hospital, Bombay, Rao Bahadur Capt. M. G. Kini presiding. There were more than 90 members present.

After the President's Opening remarks, Col. Pandalai made a touching reference to the tragic death of Dr. N. C. Joshi, a former President, and moved a resolution expressing the Association's deep sorrow and conveying to the members of his family its sincere condolences. The Resolution was unanimously passed, all the members standing.

The Secretary then read the minutes of the last General Body Meeting and the Annual Report for the year ended 31-12-47 and the audited Balance Sheet, etc., for the year ended 31-12-47, and they were passed.

The President read out the Nomination Papers submitted for the Presidential election. There were three names for the election, viz., Drs. S. R. Joglekar of Bombay, K. S. Nigam of Lucknow, and N. S. Narasimhan of Madras; Dr. Narasimhan, however, withdrew from the election. A Poll was taken. Dr. Joglekar secured 61 votes and Dr. Nigam 23 votes; two were invalid. Dr. Joglekar was declared elected President for the ensuing year.

### Amendments to Rules and Regulations

The amendments to the constitution were then duly proposed, seconded and passed by a majority of 2/3 of the members on the roll as required by the previous constitution. (A printed copy of the amended rules etc. will be posted to members as soon as it is ready.)

The Secretary then placed before the House the invitation from Patna to hold the next Conference of the Association there and it was provisionally decided to hold the 1948 Conference in Patna. It was not possible at that time to elect a Local Secretary, on account of the absence of members from Patna. Dr. P. Chatterjee of Calcutta informed the House, that in the event of there being nobody to do the work of the Local Secretary for the Patna Conference, he was willing to invite the Association to hold the 1948 meeting at Calcutta.

(Dr. U. P. Sinha of Patna has subsequently written to the Office saying that he is willing to be the Local Secretary for the Patna Conference in December 1948. The next Conference will, therefore, be held in Patna.)

Dr. S. J. Mehta and Dr. U. M. Rau then spoke eulogising the yeoman service done to the Association by the retiring Secretary, Dr. Menon.

The President in his concluding remarks expressed his appreciation of the way in which Dr. Menon the retiring Secretary had conducted the affairs of the Association during his term of Office.

Dr. Menon replying, thanked the President and

members of the Association for the kind words and for the co-operation he had from the members during his Secretaryship.

He also thanked heartily the Local Secretaries Drs. Arliur DeSa' and V. P. Mehta and their Student Volunteers for their excellent efforts in making the Conference a complete success.

Soon after the General Body Meeting, the last Governing Body Meeting was held at the same place with Dr. Joglekar, the new President in the Chair. About 75% of the members of the Governing Body were present.

Dr. Menon proposed the name of Dr. U. Mohan Rau as the next Honorary Secretary of the Association and he (Dr. Mohan Rau) was unanimously elected.

With a vote of thanks by the new Secretary, Dr. Mohan Rau, the meeting terminated.

\* \* \* \*

### Subjects for Discussion

#### 10th Meeting :

##### 1. Intracranial Tumour—

Opener : Dr. A. V. Baliga, Bombay.

Seconder : Dr. R. N. Cooper, Bombay.

##### 2. Talipes Equinovarus—

Opener : Dr. R. Kalamegham,

Trichinopoly.

Seconder : Dr. M. Bahadur Khan,  
Hyderabad.

##### 3. Surgical Complications of Typhoid—

Opener : Dr. V. G. Vaishampayan,

Sholapur.

Seconder : Dr. A. V. Baliga, Bombay.

#### 11th Meeting :

##### 1. Treatment of Elephantiasis and Lymph Oedema—

Opener : Dr. V. P. Mehta, Bombay.

Seconder : Dr. T. Kanakaraju,  
Ramachandrapuram.

##### 2. Treatment of Hernia with Fascial Grafts and Silk Sutures—

Opener : Dr. P. Chatterjee, Calcutta.

Seconder : Dr. S. K. Datta, Calcutta.

##### 3. Treatment of the Bone Cavities in Chronic Osteomyelitis—

Opener : Major D. K. Sabhesan, Madras.

Seconder : Dr. B. N. Sinha, Lucknow.

#### 12th Meeting :

##### 1. (a) Bronchiectasis—

Dr. R. Mahadevan, Vizag.

##### (b) Lung Abscess—

Dr. S. J. Mehta, Bombay.

##### 2. Intestinal Obstruction in Children—

Opener : Dr. A. E. DeSa', Bombay.

Seconder : Dr. R. A. Irani, Bombay.

##### 3. Sciatic Syndrome—

Opener : Dr. S. K. Sen, New Delhi.

Seconder : Dr. V. P. Mehta, Bombay.

# THE INDIAN JOURNAL OF SURGERY

Vol. X

JUNE 1948

No. 2

## BONE TUMOURS\*

by D. R. MEHER HOMJI.

The subject of Bone Tumours is as interesting as it is confusing. We have greatly benefited in our knowledge of bone tumours ever since the American College of Surgeons established the Registry of Bone Sarcoma in 1921. In spite of the newly made advances, we have not always successfully handled these cases of bone tumours. This failure of proper management has been due either to the mistakes in the diagnosis or to the delays in the diagnosis. If success is to be achieved, then it is our duty to detect these cases early, to make a correct diagnosis and to institute immediate and appropriate treatment.

The general practitioner, who is a liaison between the patient and the specialist, in his course of practice comes across patients with symptoms referable to the skeletal system. It is to him that these cases present major diagnostic problems. These individuals are invariably treated for a long time under the mistaken diagnosis of Rheumatism, Sprain, Arthritis, etc. Obtaining no relief, they eventually find their way to the specialist after a lapse of valuable time. The general practitioner will do well if he keeps in mind the possibility of malignancy, whenever a patient complains of unexplained pain in the bone. There is no necessity for him to assume the responsibility for the diagnosis and the treatment of bone tumours. Whenever he comes across such problems, then, in the interest of the patient, he should consult a specialist or

refer the patient to specialised clinics for a thorough diagnostic investigation.

In the diagnosis of bone tumours, the clinician, the roentgenologist and the pathologist should work as a team, for it is only through their combined efforts and close co-operation that it is possible to arrive at a correct diagnosis. Each one of these should fully realise his own limitations. The clinician must be open to the merits of different methods of treatment. The roentgenologist, at the same time, must realise his shortcomings in the interpretation of radiographic findings. The pathologist should be fully aware of his responsibilities, for any error on his part, may lead the surgeon astray in the method of treatment.

The clinician should make every attempt to take the history carefully, especially with regard to the date of onset, the presence or absence of pain, the rate of growth of the tumour, presence or absence of fever and the relationship of trauma to the onset of symptoms. The physical examination also must be thorough and complete.

Pain is the most important symptom in bone malignancy and occurs the earliest. It is usually constant and progressive and is worse at night than on exertion. Swelling usually appears later than pain, increases steadily, but the rate of growth depends upon the nature of the neoplasm. Impairment of function is usually late in onset but may occur early. The relationship of trauma to the onset of symptoms and the development of malignant tumour deserves special consideration. The question of

\*Paper read before the IX Conference of the Association of Surgeons of India on 26th of December, 1947.

whether a malignant bone tumour was caused by the trauma is one which has been disputed for many years. Much can be said on both sides, but we have seen so many patients who have given a definite history of trauma located to the part before the onset of bone tumour, that it is difficult not to believe that trauma has something to do with the origin of the lesion. However it is possible that in many cases it is the trauma that first draws the attention of the patient to the disease. The roentgenograms must be taken carefully and require skiagrams in different planes and also stereoscopic pictures. X-ray studies of the chest should never be omitted as we are aware that the bone tumours in general give rise to metastasis to the lungs by way of the blood. It may indeed be necessary to study the X-ray pictures of the skull, pelvis, spine and other bones, particularly in cases of multiple myeloma. The roentgenographic examination gives us information regarding the architecture of the tumour and other associated features which can be made out on the X-ray film. Although various characteristic appearances of the different types of bone tumours have been described in text books and in the literature, our experience has convinced us that one cannot always make a correct diagnosis from radiographic

findings alone, though one can make a correct guess in a high percentage of cases.

Having satisfied ourselves that the case in question is that of a bone tumour from clinical and radiographic evidence, then there are other features which may help us in the diagnosis of the common bone tumours. This may be tabulated as in Table I.

It is said that the osteogenic sarcoma practically never metastasize in the lymph nodes. In our series, we have cases of osteogenic sarcoma of the upper end of humerus which have metastasized to axillary lymph nodes, and confirmed by microscopic examination.

The laboratory procedures are of great importance in the diagnosis of bone tumours. These consist of chemical, serological and histological studies. Blood counts and Wassermann Reaction should be done as a routine, sedimentation rate is also of value. The leucocytic count and the sedimentation rate are often elevated in Ewing's tumour. In the analysis of urine, it is necessary to test for Bence-Jones Bodies, when there is a suspicion of the case being a multiple myeloma. It is necessary to mention here that the presence of Bence-Jones Proteinuria is not diagnostic of multiple myeloma, for these bodies have

TABLE I

	Giant cell tumours	Ewing's Tumours	Osteogenic Sarcoma	Multiple Myeloma
Age	Between 20—40 yrs.	4—20 yrs. Infrequently observed after 30 years.	10—30 yrs. Also occur in the aged when associated with Paget's disease of bone.	Usually over 40
Location in Bone	In the Epiphysis	In the Shaft	In the Metaphysis	In the Shaft
Common sites	Commonly occur in the lower end of femur, upper and of tibia, lower end of radius, maxilla.	Commonly occur in the femur, tibia, humerus, mandible.	Commonly occur in the lower end of femur, upper and of tibia, upper end of humerus.	Commonly occur in the bones of the pelvis and femur.
Metastasis	Does not metastasize.	In the lymph nodes, lungs, skull, ribs vertebrae.	In the lungs, & practically never in the lymph nodes.	Skull, ribs, vertebrae & practically never in the lungs.

also been reported, to be present in lymphatic and myelogenous leukemia, metastatic carcinoma of the bone, fibrocystic disease, polycythaemia, comminuted fractures, senile osteomalacia and multiple sarcoma of the bone. Nevertheless the presence of Bence-Jones Bodies together with the radiographic evidence greatly helps in the diagnosis. The study of peripheral blood has been thoroughly investigated by Morissette and Watkins in cases of multiple myeloma. The significant findings as reported by them were: (1) anaemia, (2) excessive formation of rouleaux, (3) immaturity of both erythrocytes and leucocytes, (4) lymphocytosis, (5) eosinophilia, (6) the presence of myeloma cells and a typical plasma cells. The study of bone marrow by Sternal puncture is also of great value in cases of multiple myeloma.

Blood chemistry in recent years has found an important place in the diagnosis of bone tumours. In all cases, a routine study of serum calcium, phosphorus, serum alkaline phosphatase and serum proteins should be made. A high alkaline phosphatase is indicative of normal new bone formation, as in fractures, or when abnormal new bone is being formed in Paget's disease of bone, osteoplastic osteogenic sarcoma, or osteoplastic metastatic carcinoma. The study of serum acid phosphatase should be carried out if carcinoma of the prostate with bony metastases is suspected. In cases of carcinoma of the prostate with skeletal metastasis, a large amount of acid phosphatase is usually though not always demonstrated in the blood serum. Recently we had a case of carcinoma of the prostate with generalised skeletal metastasis, and the study of serum acid phosphatase failed to reveal even a slight elevation. Serum acid phosphatase is also elevated in certain cases of far advanced Paget's disease of bone, but in this condition, the serum alkaline phosphatase is present in extremely high levels. The study of serum proteins is indicative in multiple myeloma. In these cases, the serum proteins are elevated, and this elevation is

mainly in the globulin fraction. The normal albumin globulin ratio is completely reversed in the direction of 1 to 3 or even 1 to 6.

Finally the most reliable procedure that we possess in our diagnostic armamentarium is the microscopic examination of the tissue removed. Here we have two methods at our disposal, aspiration biopsy and incisional biopsy. There is as yet some difference of opinion as to whether a biopsy of bone tumour should be performed or not. The necessity for a biopsy becomes evident to anyone who comes across a large number of bone tumours in his practice. More often than not, the clinical and roentgenographic diagnosis is inadequate for outlining the method of treatment. The microscopic structure of the lesion also helps us in gauging the effect of the treatment in a particular case. The aspiration biopsy, in our hands, has proved an excellent method in establishing the diagnosis. The advantages of aspiration biopsy may be briefly mentioned here as cited by Snyder and Coley. It is a simple, rapid, economical procedure. It may help in proving the diagnosis in a questionable case, and in an obvious case, it provides an histological proof. The only hazard of this method is the difficulty of interpretation. It requires unusual skill and experience on the part of the pathologist, who has to give the diagnosis from a small piece of material removed or from isolated groups of cells. At the Tata Memorial Hospital, this procedure has become a routine in cases of bone tumours, largely through the close co-operation and skilful interpretation by our pathologists. The use of incisional biopsy is often considered dangerous in cases of bone tumours, as some are of the opinion that it may produce metastasis or give rise to infection and increase the rate of growth of the tumour. In general, it may be stated that this danger is overemphasized. We employ this procedure wherever the aspiration biopsy method has failed to give us a diagnosis. It is our practice to apply a tourniquet and meticulous care is taken during the performance

of an open biopsy. The wound is never packed nor drained, but closed in layers. If these precautions are not adhered to, then there are chances of fungation of the tumour through the wound, secondary infection and acceleration of the rate of growth. I may state here that we have had no untoward effects either from aspiration biopsy or incisional biopsy. Before aspiration biopsy is carried out, the site for the insertion of the needle and its direction is decided upon after studying the radiographic picture. The site selected is usually at a point where there is a breach in the cortical bone or where the tumour has extended into the soft tissues. The technique of aspiration biopsy has been fully described by Martin and Ellis. The aspirated material in the needle is then gently extracted by means of an obturator and placed on a glass slide. To obtain a smear, another slide is placed over it, and applying firm pressure, the tissue is crushed thin between the slides, and then drawn across lengthwise. The slide is then fixed and stained with Haematoxylin and Eosin and is ready for diagnosis in from 6 to 8 minutes. The smear method has the disadvantage that it destroys the architecture of the tumour tissue. During the past three years, we, at the Tata Memorial Hospital have elaborated a technique of aspiration biopsy which maintains the architecture of the tumour and at the same time does away with the so-called dangers of an incisional biopsy. We do not profess to claim any originality about this procedure, for it might have been done by others. In this procedure, the aspirated material in the needle and in the syringe is collected on a piece of white muslin cloth spread on a petri dish containing normal saline. The petri dish is then gently tilted from side to side in order to wash off the blood. The muslin cloth containing the tissue material is then immediately transferred to a porcelain dish containing Zenker Formal solution. The small pieces of tumour tissue immediately turn yellow in this solution. These are then collected in a colloidin sac

and are then carried through the process of paraffin embedding. The procedure for preparation and staining as carried out at the Tata Memorial Hospital has been elaborately described by Khanolkar and Nerurkar. The slide thus prepared is ready for diagnosis within 24 hours.

We have had 82 cases of bone tumours, of which 13 were benign giant cell tumours, 4 malignant giant cell tumours, 24 osteogenic sarcomas, 3 chondro-sarcomas, 27 Ewing's tumours, 4 multiple myelomas, 4 reticulum cell sarcomas, 2 lipogenic sarcomas and one haemangio-sarcoma.

With regard to the treatment, I shall restrict myself to the treatment of common bone tumours.

*Giant Cell Tumour*: This tumour can be treated either by surgery or by irradiation. It must be stated here with emphasis that either surgery alone or irradiation alone yields excellent results. Due warning may also be sounded here that the combination of these two methods is not to be recommended as this is likely to lead to malignancy. Coley and Higinbotham have stated that some of their cases in which this combined treatment was used, seemed to show such a clear malignant transformation from an apparently benign state that they discontinued this practice. They thus maintain that for reasons not clearly understood, curettage and X-ray therapy do not form a desirable combination in the treatment of giant cell tumours. With regard to the choice of the method of treatment, surgery is recommended for lesions which are easily accessible, especially those around the knee, and irradiation for lesions that are inaccessible, especially those in the spine, skull, pelvis and upper end of femur. If surgery is decided upon, then we have at our disposal, (1) curettage, cauterization and primary wound closure, (2) resection and (3) amputation. The procedure of curettage can be carried out in the majority of cases of giant cell tumours. The method of resection has been recommended for lesions situated in certain non-weight bear-



ing bones e.g. fibula, ulna, ribs, and also for certain small bones e.g. patella, carpal and tarsal bones. Amputation is reserved for cases undergoing malignant transformation, for cases too far advanced for conservative procedures, and in cases of lower extremity where a useless limb has resulted from surgery or irradiation, and where a better functional result can be obtained in cases of large tumours. Irradiation is as good a method as surgery, and excellent results have been reported in the literature with this method of treatment. In the irradiation therapy of these tumours, it may be stated that there is as yet no standard technique or dosage evolved. Some treat their cases with high voltage therapy, and some with low voltage therapy. Whatever the voltage employed, smaller doses are preferable, and it is beneficial to repeat the cycle less often or at longer intervals. The treatment with heavy doses at frequent intervals gives rise to a severe reaction which has been referred to as Herenden Paradoxical reaction. The tumour increases in size in from 3 to 4 weeks. The skin becomes markedly red and oedematous, there is marked pain and tenderness, there occurs expansion and thinning of the bony cortex and the trabeculae become so washed out that there remains hardly any vestige of bony detail. The roentgenologist treating these cases must be well conversant with this phenomenon, and should not consider these occurrences as signs of failure. Masterly inactivity should be the rule during this period except that the limb be well supported. After these changes subside, pain and tenderness disappear, the swelling and redness abate, the tumour becomes firm, and if the X-ray pictures are taken during this period they will demonstrate signs of bone regeneration and calcification. Once these changes are taking place, it is best in the interest of the patient to withhold further irradiation. At the Tata Memorial Hospital, the irradiation technique utilised is as follows: 200 K.V., 0.5 mm. Cu. and 1 mm. Al filter, 50 cm. T.S.D. A dose of 200 r in air is administered to

each port for a total dose of 1200 r to 1600 r. Of the 13 cases of Benign Giant Cell Tumours, 4 were in the upper end of tibia, 2 in the lower end of ulna, one in the lower end of radius, one in the lower end of femur, one in the ileum, one in the upper end of fibula, one in the temporal bone, and two in the upper end of humerus. Eight cases were treated by X-ray therapy, 2 cases by resection, and 2 cases by amputation. One case had no treatment. Many of our patients were reluctant to subject themselves to surgery and hence were treated with X-rays. We are quite satisfied with the treatment by X-ray therapy and five of these cases have been followed up for more than two years. As an illustration, I shall briefly relate the case history of a 23 year old Hindu male (Case No. 354) who applied to us on 14-5-1941 with the history of injury to right knee two years ago, with immediate pain lasting for four months, and disability to walk for six months. About nine months later he developed a swelling in the region of right knee. A clinical diagnosis of osteoclastoma of the upper end of right tibia was made, and this was confirmed by radiographic pictures. Aspiration biopsy was reported as Benign Giant Cell Tumour and the patient was started on X-ray therapy, and a total dose of 1500 r was given to each of four ports. Thirteen months after the X-ray therapy the radiographic pictures revealed filling up of the trabeculae with dense bone.

With regard to malignant giant cell tumours, the method of treatment is radical surgery. We have had four cases of malignant giant cell tumours in our records and all have terminated fatally. A 24 year old Hindu male (Case No. 5343) was admitted to the hospital on 27-9-43 with the history of injury 15 months ago, on the outer aspect of the right leg just below the knee. Pain developed immediately. He noticed a swelling four months after the initial injury. A clinical diagnosis of Benign Giant Cell Tumour was made from physical examination. The roentgenologist's report was also Benign Giant Cell Tumour.



Aspiration biopsy failed to reveal any tumour material and a formal biopsy was performed and reported as malignant giant cell tumour (Jaffe grade II). Amputation above the knee was performed. A sinus persisted at the stump for six months. He remained well for  $2\frac{1}{2}$  years after the operation when he complained of pain and swelling of the stump and there was a granulation tissue like mass at the site of original sinus. This was biopsied and the report was malignant giant cell tumour Jaffe grade III. Disarticulation at hip was performed and one month later he developed pulmonary metastasis and expired two months later.

With regard to *Ewing's tumour*, radiation therapy is the treatment of choice. Although these tumours are highly radiosensitive, and disappear completely after irradiation therapy, they have the tendency to metastasize widely in the lungs and other bones, so that the ultimate outlook is a fatal one. We have had 27 cases of Ewing's Tumour, of which 24 were biopsied at our hospital. Of the 24 cases that were biopsied, 22 were reported as Ewing's. Of the 22 cases with positive biopsy, the diagnosis of Ewing's tumour was obtained by aspiration biopsy alone in 13, and all these responded to X-ray therapy. In 5 cases aspiration biopsy was not conclusive and in 5 of these the diagnosis was obtained by formal biopsy. Formal biopsy alone was performed in 5 cases. In one case, aspiration biopsy was reported as malignant tumour and later confirmed by a formal biopsy. In one case the formal biopsy was performed outside. Two cases were amputated outside, and the outside slides were reviewed by us. Of the 27 cases, 7 were in the femur, 7 in the tibia, 2 in ribs, 5 in the pelvic bones, 2 in the skull bones, 2 in the fibula and 2 in the humerus. Out of the 27 cases, only 19 were treated by X-ray therapy. Four of these died in the hospital. Of these four one remained free of disease for 2 years after treatment, one lived for  $1\frac{1}{2}$  years after treatment, one for one month after treatment, and one for 10 days after treatment. The rest were fol-

lowed for periods of 4 to 13 months after treatment and then were not seen, and are presumably dead. Here I would like to illustrate a case of 24 year old Christian male (Case No. 7361) who applied to us on 28-6-44 with history of pain in the right pubic region of 6 months duration, and a vague painless swelling in the same region of 2 years duration. He gave no history of trauma and walked with a limp for the past three months. Physical examination revealed an indefinite swelling involving the superior ramus of the right pubic bone. A clinical diagnosis of malignant tumour of the pubis of the nature of Ewing's was made. Radiographic studies revealed Ewing's tumour. Lung fields were normal. Aspiration biopsy confirmed the diagnosis of Ewing's tumour. Patient was started on X-ray therapy (3500 r to each of 2 ports). Patient responded to X-ray therapy, with complete disappearance of pain and swelling. Two months after treatment X-ray studies revealed formation of new bone. On 9-7-45 that is 13 months later, patient reappeared with pain in the chest and cough of 20 days duration. X-ray studies of the chest revealed bilateral pulmonary metastasis. He was treated with X-ray therapy with complete disappearance of pain and metastasis. He then developed metastasis to the left 8th rib on 29-8-45 and responded completely to X-ray therapy. On 23-4-46 that is 22 months after his first visit he developed metastasis in the right clavicle and on 10-5-46 he developed paraplegia from 10th dorsal downwards and died in the month of August of 1946. He thus lived for 26 months from the date of first application to the hospital and exactly for 2 years after the initial X-ray therapy.

In cases of *Osteogenic Sarcomas*, radical surgery is the only method of treatment, and this may entail amputation or disarticulation. The success of radical surgery mainly depends upon it being carried out in the absence of distant metastasis. Once a diagnosis of osteogenic sarcoma has been definitely made, then there should be no

waste of time either on the part of the patient or the surgeon. The generally accepted procedure of choice is amputation above the proximal joint of the bone affected. In the case of upper extremity, interscapulo—thoracic amputation is the only procedure when tumours involve the upper end of humerus. We have had 24 cases of osteogenic sarcomas. Of the 24 osteogenic sarcomas, 12 involved the lower end of the femur, 5 upper end of humerus, 2 upper end of fibula, 3 upper end of the tibia, one clavicle and radius. Of the 24 cases, only 13 received treatment. Amputation was performed in 6, disarticulation at hip in 3, and interscapulo—thoracic amputation in 4. Of the 13 treated cases, one died at the hospital 14 months after treatment. Two have remained well after treatment for one and two years respectively. Another case remained well and free of disease for 18 months after treatment when he developed generalised metastasis and expired. A British soldier on whom we performed an interscapulo—thoracic amputation was invalided to England and was lost to follow up. We had one case of osteogenic sarcoma superimposed on Paget's disease of bones and expired at his native place 6 months after amputation. Three were followed for periods of 6 to 9 months after treatment. The remaining have been lost to the follow up department and are presumably dead. As an example, I will describe a case of osteogenic sarcoma of the upper end of humerus with axillary lymph metastasis. A 24 year old British soldier (Case No. 3120) was admitted to the hospital on 29-9-42 with the history that whilst lifting a heavy weight, he felt a sudden pain on top of his left shoulder. Six months later a painful swelling appeared. On examination, he had a fusiform enlargement of the left shoulder. X-ray studies revealed osteogenic sarcoma involving the upper end of left humerus. Alkaline phosphatase level was 11.4 Bodansky Units. Interscapulo — thoracic amputation was performed together with the removal of axillary areolar tissue. Microscopic report on the specimen

removed was osteogenic sarcoma with infiltration of marrow cavity, the deltoid muscle and metastasis to two axillary lymph nodes. Alkaline phosphatase after the operation had fallen to 3.6 Bodansky Units. He received post-operative irradiation, and was later invalided to England.

In case of *Multiple Myeloma*, X-ray therapy is the treatment of choice. These tumours are radiosensitive, but the outcome of the patient is quite hopeless. In recent years, Stilbamidine and Pentamidine (Diamidine compounds not containing antimony) combined with a diet low in animal protein are used in the treatment of multiple myeloma for the relief of pain. The disease is not cured by these drugs, but is temporarily checked in its further development. We have no experience with these drugs in these cases.

We have had four cases of multiple myeloma, all microscopically proved by aspiration biopsy. All have died. One lived for 10 months after treatment, one for 7 months after treatment, one for 6 months and the 4th one for three months after treatment. They were all treated by X-ray therapy. A 53 year old Parsi female (Case No. 5282) was admitted on 17-9-43 with the history of pain and swelling over the right shoulder of six months duration. Pain appeared first, and two months later the swelling. There was a rounded swelling involving the scapula, and a clinical diagnosis of a possible giant cell tumour was made. Radiographic interpretation was osteolytic osteogenic sarcoma. Aspiration biopsy was reported as plasma cell myeloma. X-ray studies of the skull and other bones revealed no abnormality and so the case was thought to be a solitary myeloma. Bence-Jones Bodies were present in the urine. Blood chemistry revealed hyperproteinaemia and the albumin globulin ratio was one to one. Patient was treated with X-ray therapy (1800 r) with complete disappearance of pain and tumour. Three months after the completion of X-ray treatment, she developed pain in the lower back, and also small masses on the vertex of the skull. X-ray studies

revealed similar lesions as the previous one. She was treated with X-ray with marked relief of pain. She later developed similar lesions in the ribs and a pathological fracture involving the upper end of left humerus. She ultimately expired on 7-6-44, nine months after the date of first application.

With regard to the other malignant tumours, Reticulum Cell Sarcoma of the bone is a relatively infrequent tumour. It is radiosensitive and can be treated with deep X-ray therapy. We have had four cases of Reticulum Cell Sarcoma. One case of ours is alive for the last four years, although crippled. We had two cases of lipogenic sarcoma, and one was treated with X-ray therapy and was followed for six months after treatment.

### PROGNOSIS

Of all the bone tumours, giant cell tumours have the best prognosis. A large number of permanent control of these tumours following irradiation have been reported in the literature. Surgery in the nature of curettage, cauterization and primary wound closure is said to be followed by recurrence in 25% of the cases, but those who advocate this procedure maintain, that if this procedure is carefully carried out, it also gives rise to a large number of permanent cures. Ewing's tumour has a poor prognosis. Of 114 cases seen at the Mayo Clinic as cited by Ackerman and Regato, 21 lived five or more years. Of these, 8 had amputations, two had wide excisions and eleven were treated by radiation (Meyerding). The Registry of Bone Sarcoma as cited by Ackerman and Regato reported on 55 cases which were followed for 5 years or more, and there were 15 five-year survivals. Geschickter reported 135 cases with only 6% five-year survivals. The prognosis of osteogenic sarcoma depends upon many factors e.g. age. Patients between the ages of 20 and 40 years seem to

have the most favourable prospect of five-year survival, whereas patients under 20 and over 50 have the least favourable outlook. Osteogenic Sarcoma occurring in a case of Paget's disease gives rise to a very poor prognosis. Location of the tumour is also important from the prognostic point of view. When these tumours occur in areas where they cannot be surgically removed, e.g. vertebra, skull, pelvis, the prognosis seems hopeless. According to Coley and Pool, the more peripheral the tumour, the more favourable the prognosis. Conversely the more nearer the tumour to the trunk, the worse the prognosis. The microscopic grading of the tumour is also of great importance in regard to the prognosis (Uniformity or pleomorphism of cell type).

Coley and Pool have divided their cases into tumours of low, average and high grade malignancy. They have shown that of 36 cases with tumours of low grade malignancy, 40% survived five years, of 98 with tumours of average grade malignancy, 16% survived five years, and of 26 with high grade malignancy 15% survived five years. The type of treatment employed also influences the prognosis. Amputation alone or with preoperative radiation has given 32% five year survivals in the series reported by Coley and Pool. Radiation alone was used in 35 cases with 3 survivals or 9%. They have reported 35 five-year survivals out of a total of 160 histologically proved cases, thus giving them a five-year survival rate of 22%. A case of multiple myeloma has the most fatal prognosis. The average life expectancy ranges around 14 months.

I have endeavoured in the short time available to cover the subject of Bone Tumours, touching only on some of the important problems that we have met with in our experience. I am sure that there are various other problems that have received scant notice in this paper and I trust that they will be brought out in the discussion that will follow.

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# OBSERVATIONS ON OSTEOGENIC SARCOMA AND OSTEOCLASTOMA

by M. G: KINI.

## TUMOURS OF BONE

*"Do not fear to defend new ideas even the most revolutionary. Your own faith is what counts most. But have courage also to admit an error as soon as you have proved yourself that your idea is wrong. Science is the graveyard of ideas but some ideas that seem dead and buried may at one time or another rise up to life again more vital than ever."*

—LOUIS PASTEUR.

Tumours of the skeletal bones are varied and the pathology of these tumours is being put on a rational basis. Benign tumours of the type of Osteomas are excluded from the purview of this paper. Osteogenic sarcomas and giant cell tumours are included in the scope of this paper.

The work of Kolodny, Codman, Copeland and Geschickter, Ewing, Plattjaffe, Macdonald and Budd and the American Registry of Bone Sarcomas have helped to have a clearer view of the bone tumours in general and sarcomas and benign giant cell tumours in particular. This classification has given us a fair indication of the way in which we can approach this subject.

Recorded evidence in India is meagre in this respect. The object of this paper is to focus the attention of the surgeons with regard to incidence, causation, pathology, treatment and follow up results. An attempt was made to keep a record of the incidence of the bone tumours seen in the outpatients and inpatients. 100 cases were recorded from 1932 to 1941. Unfortunately, the register in which these were recorded in the advanced stage of the disease and who were not considered suitable for admission were seen as outpatients only, to prevent overcrowding in the hospital, and the record of these cases has been lost. The following 49 cases of osteogenic sarcoma and 17 cases of benign cell tumours of which there is complete recorded evidence,

shows that this type of disease is not less common in India.

## OSTEOGENIC SARCOMA

Bone sarcomas usually occur among the younger people. The appended statement gives the details of incidence, pathological details consisting of biopsy-reports, histological findings after amputation and post-mortem findings with photographic evidence consisting of clinical photographs and radiological pictures of 49 cases of sarcomas and 17 cases of osteoclastomas or benign giant cell tumours.

The average duration of the disease in respect of the above 49 cases when they sought admission was 6 months and 23 days. The shortest duration was 23 days, the longest being 2 years. 32 were males and 16 females and one was a male child. It is possible that we cannot place much reliance on the history given by the patients as they were all illiterate and the assessment of the duration of trouble given by them must have been from the time when the disease became very appreciable to the naked eye and became more painful.

The following statement gives at a glance the site of the tumour, i.e. the commonest sites where these tumours are usually occurring, sex, side, average age of the individuals and easy reference to age for quick comparison with the detailed statement of cases. The numerators in the age reference column indicate the serial number

Site.	Sex		Side		Total		Age			Age reference to statement	
	M.	F.	Rt.	Lt.			Ave- rage	Youn- gest	Oldest		
Femur	...	11	5	...	6	10	16	22.2	7	60	3-60, 7-20, 10-16, 16-16, 17-22, 18-30, 20-25, 24-25, 31-7, 38-20, 40-21, 41-21, 42-15, 43-21, 46-18, 49-17.
Tibia	...	5	6	..	4	7	11	23.1	15	30	1-20, 2-25, 8-16, 11-25, 12-15, 14-20, 15-20, 21-28, 22-30, 36-30, 47-25.
Humerus	...	5	2	.	3	4	7	21.0	14	32	4-18, 17-20, 28-14, 33-20, 34-25, 39-18, 45-32..
Ileum	.	4	...	...	2	2	4	28.8	15	56	5-25, 23-23, 32-56, 35-50.
Scapula	...	3	..	...	2	1	3	23.3	18	30	16-18, 37-23, 44-30.
Skull bone	...	1	..	..	1	...	1	25.0	...	...	13-25.
Maxilla	...	...	1	...	1	...	1	25.0	...	...	29-25.
Radius	..	...	1	...	..	1	1	25.0	...	...	26-25.
Ulna	...	1	...	...	1	...	1	25.0	...	...	25-25.
Metacarpal	...	1	...	...	1	...	1	30.0	..	...	30-30
Phalanges	...	..	1	...	1	...	1	30.0	...	...	48-30.
Fibula	...	...	1	...	1	1	1	40.0	...	...	19-40.
Metatarsal	...	1	..	...	1	1	1	50.0	...	...	9-50.
Total	...	32	17		24	27	49				

of the cases in the detailed statement and the denominators the age of the case.

44 out of the above 49 cases have photographic evidence, majority of them have both clinical as well as x-ray photographs. Of the five remaining cases, x-rays have been lost. All the 17 cases of osteoclastoma have got either clinical photographs or both clinical and radiological photographs or radiological picture only.

In the case of the osteogenic sarcomas, the history of an injury as a precursor of the disease is not borne out by the recorded evidence.

The causation of sarcoma is not clearly understood. The experimental study of Peyton Rous with regard to the fowl and rabbit sarcoma shows that virus infection plays a part in the production of sarcoma. The work of the Russian microbiologist Nikolai Gamalai shows that malignant tumour is the result of virus infection which by penetrating into the cell causes intensive multiplications on the

analogy of Infusoria who free themselves of bacteria which have penetrated into their nuclei by intensive multiplication of cells in seeking to eject the virus into the protoplasm. Prof. Levi Zilber believed that the virus having caused transformation of animal cell into tumour cell perishes or separates itself from the tumour cell as the modified cell has become uncomfortable for its existence and therefore it is difficult to demonstrate the virus in the adult tumour cells. Therefore it is presumed that the tumour virus differs from the other viruses of infectious diseases.

Bone reacts to infection in somewhat similar way as is seen in sarcoma and having a rich reticulo-endothelial system it is quite possible that the bone in its effort to shake off its virus infection may turn malignant, and lead to the development of bone sarcoma. It would be a fruitful source of research to elucidate the cause of sarcomas bearing this in mind. Most of the cases of sarcomas seek advice for pain from

the very start, particularly marked at night causing sleeplessness. As a matter of fact, pain of infection and sarcoma are almost identical with this exception that the constitutional reaction early in the disease is greater in osteomyelitis than in sarcoma and the constitutional changes in sarcoma occur later in the disease.

In presenting this paper, it is premised that no special work with regard to this has been done though the material was ample and co-ordinated work could not be carried out due to imperfect organisation and equipment. The average practitioner and general surgeon in India, less conversant with bone sarcomas and having no post-graduate education does not diagnose this disease and sometimes makes mistakes by wrongly diagnosing these as cases of osteomyelitis and incise the tumour. Sometimes, indigenous practitioners who are considered tumour specialists apply irritant drugs hoping to dissolve the tumour, and exacerbate the disease after the first or the second application. Sometimes these tumour areas are cauterised by the usual country thermo cautery, as a counter irritant for the intense pain and after this procedure, the tumour takes on a more malignant course with rapid dissemination. The dissemination of this disease is usually in the lungs but the following cases are of interest as the dissemination occurred in other parts of the skeleton mostly on the same side as the original growth.

Case No. 1—this was incised mistaking it for an abscess and the dissemination was presumed to have occurred in the left humerus because she suffered from intense pain exactly two months after the incision and died 5 months after.

Case No. 5—is an illustration of the dissemination of the disease from the right iliac bone to the right humerus and right temple.

Case No. 6—after excision of rt. scapula, recurrence occurred locally and dissemination occurred in the right iliac bone.

Case No. 37—was given electrical massage and incised and secondaries occurred in the lung.

It is not clear as to why dissemination should occur on the same side of the skeleton and not in other parts of the skeleton as the dissemination is by the blood stream.

Cases Nos. 8, 17 and 42 were suggestive of Ewing's sarcoma.

Case No. 8 was cytologically suggestive of Ewing's sarcoma but the radio-therapeutic test was negative.

Case No. 17—was suggestive of Ewing's sarcoma radiologically, but the therapeutic test by x-ray could not be done and the biopsy report was suggestive.

Case No. 42—was suggestive histologically but the radio-therapeutic test was negative.

Case Nos. 5, 6 and 9—died in the hospital and complete post mortems were done.

There were four cases of Chondrosarcoma—one in the meta-carpal of the hand, one in the metatarsal of the foot and one in the upper end of the tibia and one in the phalanx of the hand. Cases No. 30, 9, 14 and 48.

Case No. 9—died suddenly on the day posted for an amputation. He had developed gangrene. A post mortem was done. Nos. 14 and 30 were amputated—see Figs. 12, 17, 17-a, 32 and 32-a.

The difficulty in diagnosis becomes obvious only when we make a follow up study. The following atypical cases are of interest.

Case No. I—a woman who was admitted for tumour of the lower end of the femur in the wards, aged 35 years, was diagnosed from radiological appearance as a case of sarcoma of femur and she was advised amputation which she promptly refused and obtained her discharge from the hospital. On follow up after three years, she stated that she was keeping very fit. Though she was asked to come for re-investigation, she pleaded poverty to come and report. It was presumed that it was a case of syphilitic infection of the bone, as

no case of sarcoma could have lived after three years without any treatment. Fig. 1 & 1-a.

Case No. II—a case of ulcerating growth of the wrist with thickening of the bone was admitted as a case of ulcerating sarcoma of bone. Radiological picture is not available as it has been lost. After a therapeutic test, the healing was complete. Fig. 2 & 2-a.

Case No. III—a girl aged 16 years admitted for swelling in the thenar eminence which resembled a tumour with ulceration and foul smelling discharge. The ulcers on the radial border were typically gummatous. This is illustrated to show that a careful assessment of ulceration is essential in differential diagnosis. Antisyphilitic treatment with removal of the metacarpal of the thumb which was secondarily infected and sequestered cured this condition. Fig. 3 & 3-a.

Case No. IV—a Hindu, male, aged 35 years, was admitted for a tumour in the lower end of the femur. On clinical examination, it appeared like a case of sarcoma and the radiological picture showed it to be a sclerosing type of sarcoma. On therapeutic test, it proved to be a case of specific osteo-periostitis. Fig. 4.

Case No. V—Hindu, male, aged 40 years, admitted for swelling in the medial aspect of the thigh with intense pain was diagnosed to be a case of sarcoma. Radiological picture shows erosion below lesser trochanter with parallel thickening of cortex on medial aspect below. On therapeutic test, it was proved to be due to syphilitic infection of bone. Fig. 5.

Case No. VI—(not illustrated) was a young Indian Christian, aged 25 years, consulted a surgeon of repute for a swelling in the upper end of the right leg. Radiological examination showed expansion of the upper end of the fibula with lamination and rarefaction suggestive of a Ewing's sarcoma. He was advised amputation by the surgeon who saw him. Subsequently, a second medical opinion decided on giving a therapeutic test for syphilis which proved to be negative. Later he was sent for a course of irradiation by deep x-ray by an expert radiologist. Biopsy was not done. The

tumour showed signs of re-calcification and differentiation of the cortex and medulla. He went home and subjected himself to indigenous treatment and now after 7 years he is alive. This individual is rather an extraordinary man and he would not come back or get himself re-xrayed in spite of persuasion and he believes that the cure was due to indigenous medicine. It is not possible to illustrate this case as all the x-rays are in the possession of the patient and he is refusing to give them even for taking prints.

The only reason for presenting this paper is that every case of tumour of bone that comes to the hospital for treatment should have an organised and clear cut method of approach in the diagnosis and treatment.

1. A clear history of the case should be taken. This is one of the things lacking in most of the clinical institutions in India.

2. A study of the blood such as, blood picture, Wasserman reaction, biochemical examination for blood calcium, blood phosphatase, etc. etc.

3. A good radiological picture efficiently taken and studied correlating it if possible with pathological findings.

4. A therapeutic test not depending upon the Wasserman or Kahn tests. It is always found that if the pathology is due to syphilis after the administration of three injections of arsenical preparations, the pain begins to subside and the patient begins to show improvement. Syphilis can mimic any type of tumour inclusive of sarcomas of bone—cf. Figs. 1, 1-a, 2, 2-a, 3, 3-a, 4 and 5.

Case No. 16 is a case which illustrates that though the Wasserman was strong positive, radiologically it was difficult to assess the pathological condition. Treatment by antisyphilitic drugs had no effect. Later radium implantation was done and the condition improved and she lived for 2 years. She gave birth to a child and died 6 months afterwards of the same disease. It is presumed that it was a case of Ewing's tumour from the radiological picture and reaction to radium and follow up. X-ray therapy may help to differentiate sarcomas from



Ewing's tumour which is very radio-sensitive.

It has not been possible in the earlier part of the investigations to correlate the x-ray therapeutic test for differentiating osteogenic sarcomas from Ewing's tumour. Interstitial radiation was tried in a few cases instead, with doubtful results.

5. Treatment by deep x-rays is useful and facilities should be provided. In the earlier part of the study of the problem no facilities for this method of treatment were existing and in recent times it has been advocated to give a tumour dose of deep x-rays before amputation. Such treatment has prolonged the life of the amputees.

6. A biopsy study wherever possible. This should be undertaken in the case of sarcomas when therapeutic tests are negative and before sacrificing the limb. After the application of a firm tourniquet above the site of the tumour, aspiration, suction or Turkel trephine biopsy should be done from the tumour below the tourniquet. There should be facilities for immediate biopsy report by studying frozen sections. Development of a team is essential to avoid pitfalls.

In this connection it would be interesting to recall the experience of Stephen Paget in the St. Bartholomew's hospital, London. In this hospital it was the practice that general consultations should be held as a routine before a limb was sacrificed. One case was pronounced after due consideration by all surgeons to be a case of sarcoma and amputation was advised and done. Eventually after amputation, on section it was found to be a case of chronic osteomyelitis with a small sequestrum in the centre of the swelling surrounded by a lot of thick new bone formation. This is now commonly known in literature as "quiet necrosis of Paget" and the specimen has been preserved.

7. Amputation of limb may be undertaken. Chondro-sarcomas were amenable to this type of treatment. Cases Nos. 14, 30 and 48.

It has not been possible to demonstrate the dissemination of the disease by means of radiograms after amputation, before they were discharged from the hospital.

Those cases that had shown dissemination have died. The published literature states that even after amputation, no cure can be guaranteed.

In this connection I wish to draw the attention of all surgeons to the difficulties of advising this procedure. Case shown in Fig. 1 is an illustration. This advice was given by my assistant in 1933 when I was on leave and this case was filed with x-ray reduction picture in the sarcoma file. A follow up was attempted in 1940 and the reply was astonishing. A careful study of her notes and x-rays was made. Her blood Wasserman test was + + +. A therapeutic test would have settled the question.

Amputation of limbs can also be undertaken in advanced cases to prevent loss of blood and save the patients from foul smell from the fungating tumours after inadvertent incisions that were made mistaking the tumour for an abscess. Case No. 1 had a foul smelling growth after incision and had secondaries. In spite of this amputation was done.

In case No. 49, even though there were secondaries in the lungs, the case was amputated as he had intractable pain.

8. Last of all it is essential to impress on the Government the necessity to have a register for malignant diseases in general and tumours of bones in particular. The prognosis of cancer has altered since the advent of x-ray and radium but in the case of sarcomas it is disappointing. The following analysis shows that the tale of sarcoma is a tale of woe and no case which has been conclusively proved to be a case of sarcoma has lived over a period of time. An attempt at follow up was made of all cases to find out,

(i) the duration of life after a firm diagnosis of sarcoma was made with the help of special investigations, and,

(ii) whether the diagnosis made was correct.

In most cases follow up was not successful. In successful cases results were disappointing.

The following is an analysis of cases where treatment was advised and adopted:—

- A. Advanced inoperable cases and unsuited for any type of treatment—Nos. 23, 27, 28, 32, 33, 34, 35, 37, 39.
- B. Treated by deep x-ray—Nos. 8, 42 (No. 8 died at home).
- C. Treated by excision with recurrence—No. 6 (died in hospital, post mortem done).
- D. Those that had secondaries already and unfit for treatment—Nos. 1, 3,

5, 40 & 49 (3 and 5 died in Hospital. Post mortems done).

- E. Treated by interstitial radiation—Nos. 2, 13, 16, 19 (16 died at home, 2 years later and six months after giving birth to a child).
- F. Treatment by excision or amputation of cases which consented to this line of treatment—Nos. 9, 14, 29, 30 (9 died suddenly on the day fixed for operation. Post mortem done).
- G. Treated by amputation of cases which consented to this procedure to save them from the bad smell due to bleeding or severe pain—Nos. 1<sup>a</sup> and 49<sup>a</sup> (shown under item D).
- H. Discharged otherwise—Nos. 4, 7, 10, 11, 12, 15, 17, 18, 20, 21, 22, 24, 25, 26, 31, 36, 38, 41, 43, 44, 45, 46, 47, 48.



Fig. 1.

Clinical photo of the lower end of the femur in the region of the knee mistaken for sarcoma and the patient was advised amputation.

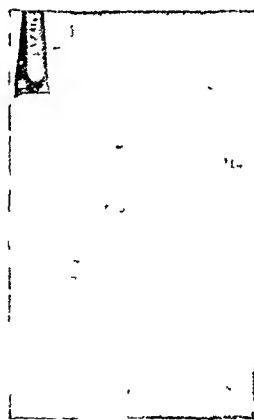


Fig. 1-a.

Shows evidence of periosteal reaction with dense deposit of bone with decalcification in the centre resembling a sarcoma—on follow up with indigenous treatment she was found to be alive and is presumed to be syphilitic.



Fig 2.



Fig. 2-a.

Clinical photographs of the wrist showing ulceration with thickening of the lower end of radius mistaken for ulcerating growth of lower end of the radius. This was proved to be due to syphilis after therapeutic test.

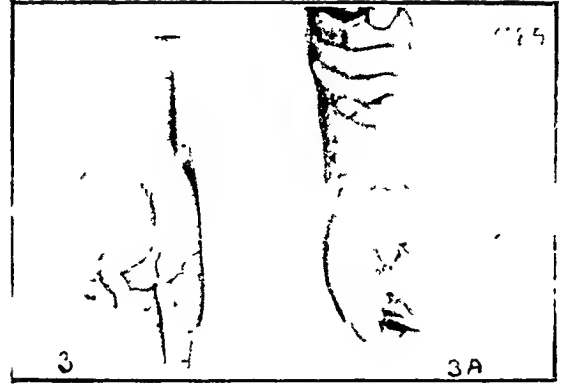


Fig. 3 & 3-a.

Clinical photographs showing the swelling in the region of the thenar eminence—may be mistaken for Chondroma but the dorsal view showed ulceration characteristic of syphilis.



Fig. 4.

Radiogram of the lower end of the femur easily mistaken for sarcoma with dense osteo-periosteal reaction with formation of new bone. This was proved to be due to syphilis after therapeutic test.

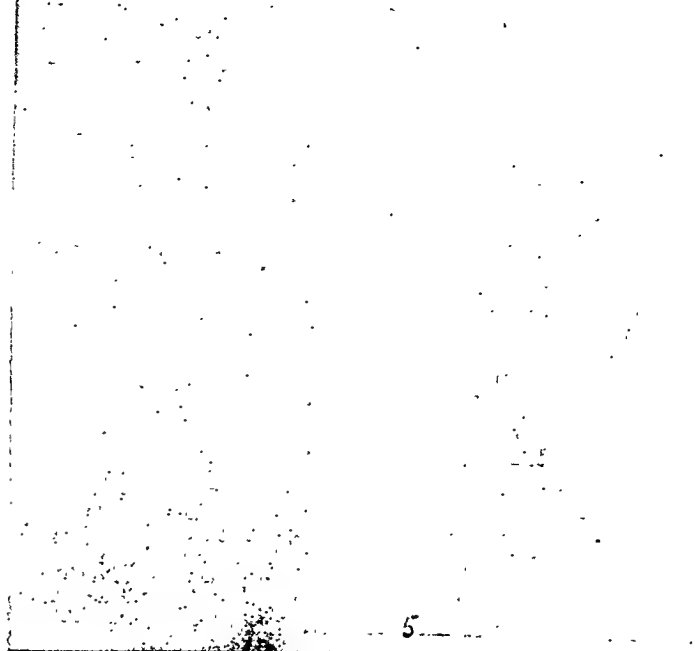


Fig. 5.

Shows a growth on the medical aspect of the upper end of the thigh—shows rarefaction below the lesser trochanter and new bone formation parallel with the shaft of the bone easily mistaken for sarcoma—this was proved to be due to syphilis.



Fig. 6.

Clinical photograph of sarcoma of tibia—note fungation result of incision thinking it to be an abscess.

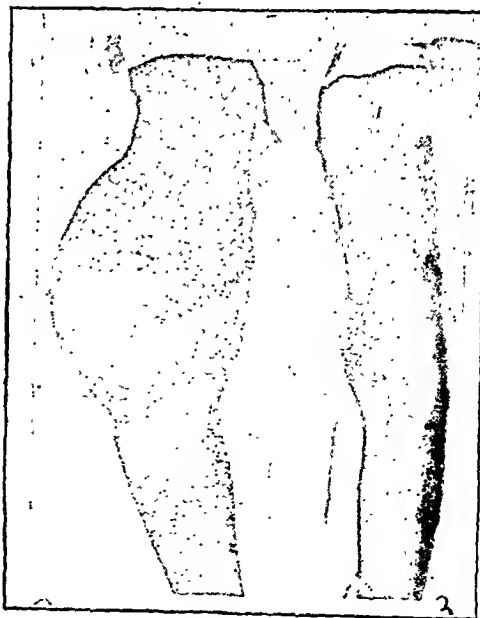


Fig. 7.

Clinical photo showing the tumour in the region of the right knee.

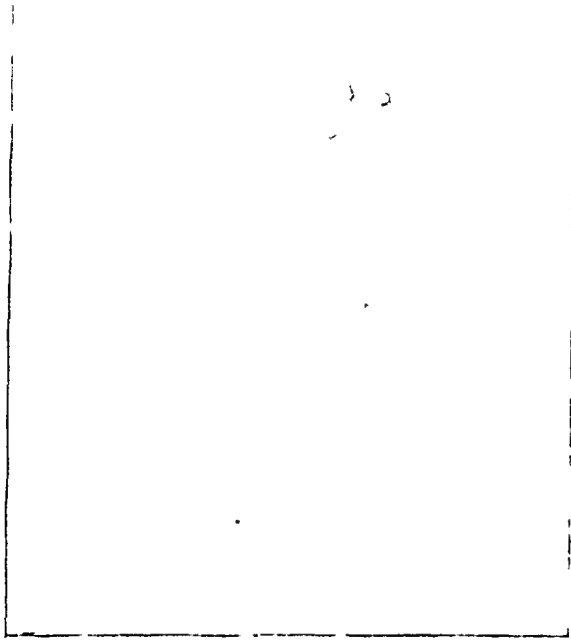


Fig. 7-a.

Radiograph showing a diffused growth with spicules of bone extending into the growth—the cortex and medulla are not easily seen in the photo having been masked by the growth.

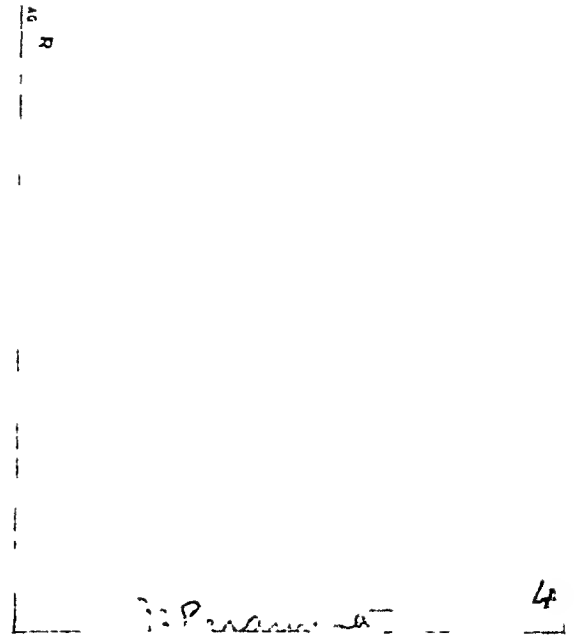


Fig. 8.

X-ray picture of the upper end of the humerus—note the diffused growth extending from the upper end to the junction of the middle and lower third of the humerus—note the rarefaction of the bone shaft in the middle of the growth with new bone formation giving sun-ray appearance.

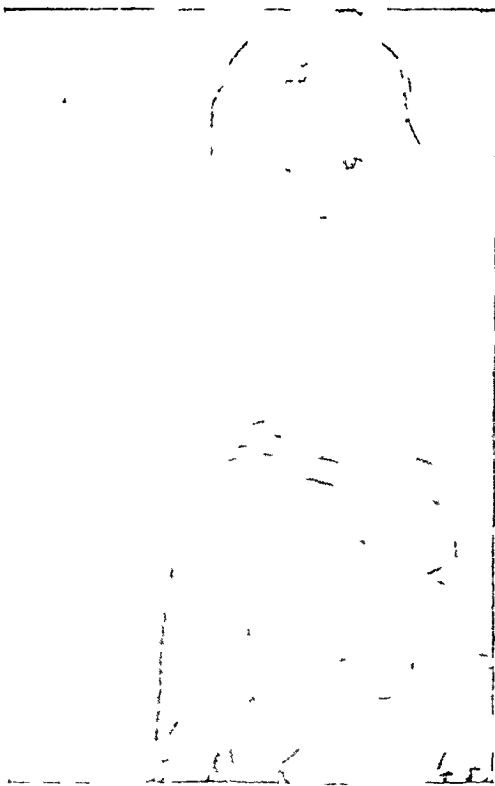


Fig 8-a.

Clinical photo of the same case.

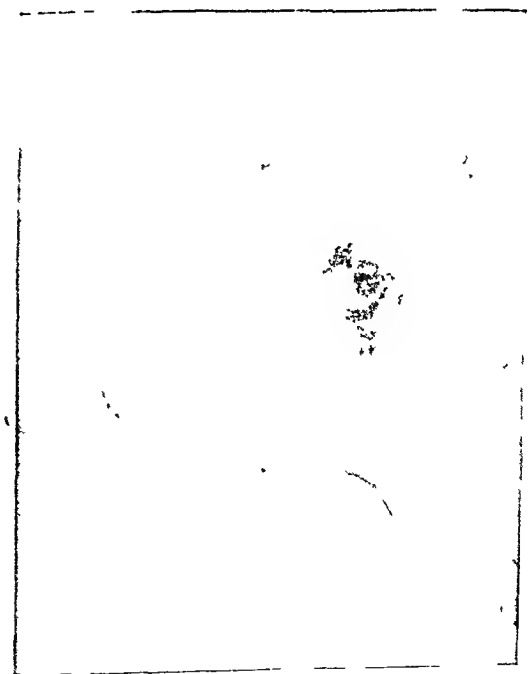


Fig 9.

Radiogram showing the diffuse thickening of the ilium extending from the upper margin of the acetabulum on the left side.

1963

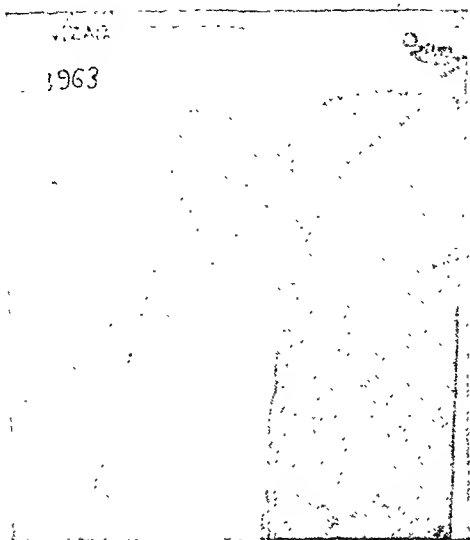


Fig. 9-a.

X-ray of the upper end of the left shoulder (but reversed during printing) showing the periosteal beaking of Codman.

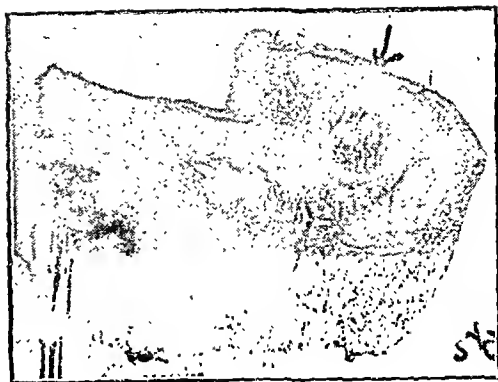


Fig. 9-b.

A pathological specimen removed showing the growth in the skull from within.

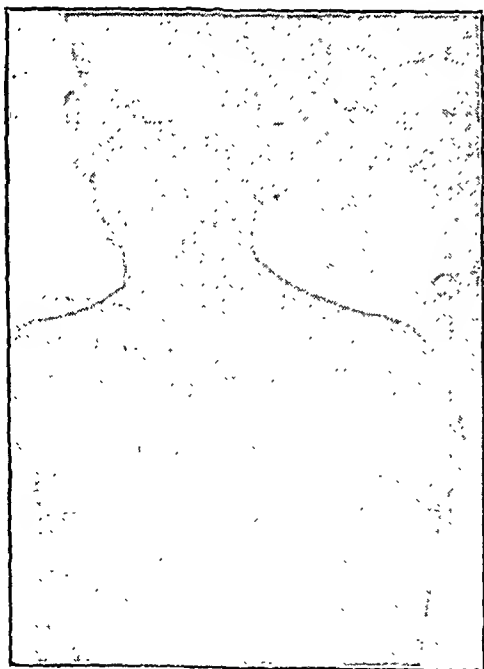


Fig. 10.

Shows the back view of the growth from the right scapula.

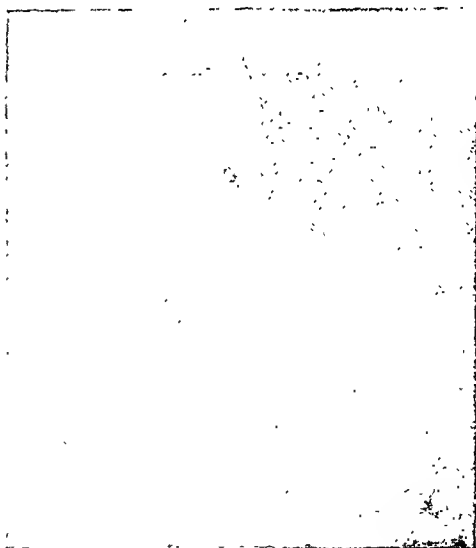


Fig. 10-a.

Shows the x-ray which is not quite clear—shows the tumour is mottled with the bony structure.

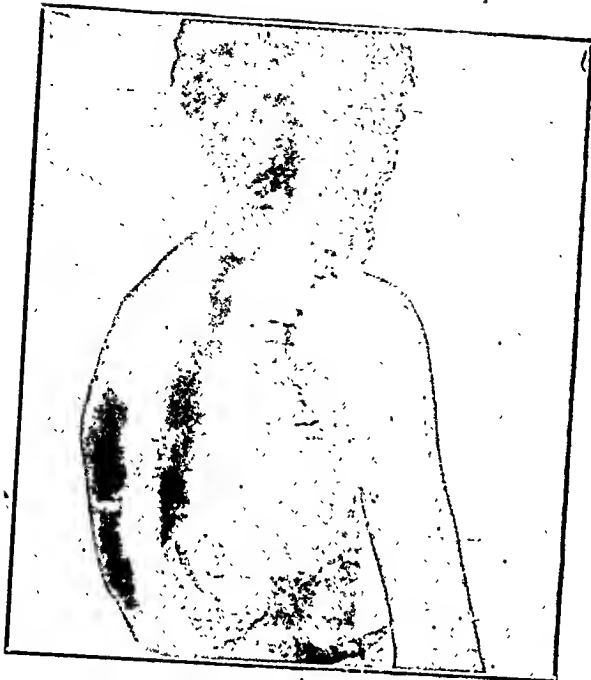


Fig. 10-b.  
The case after operation (excision).



Fig. 10-c.  
Recurrence of the growth after 6 months (back view).



Fig. 10-d.  
Recurrence of the growth after 6 months (front view).

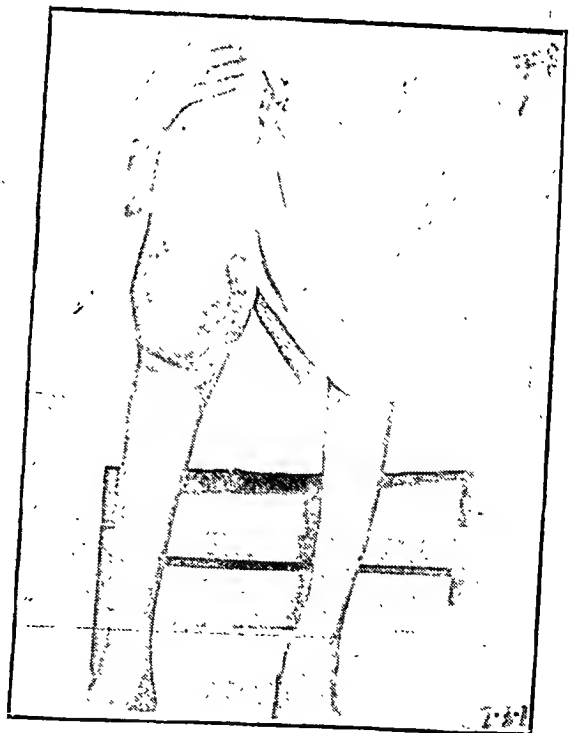


Fig. 11.  
Clinical photograph of the growth in the lower end of the femur.



Fig. 11-a.

Photograph showing the growth in the lower end of the metaphysis and diaphysis of the femur—shows sun-ray appearance and spicules with evidence of beaking in the upper part as described by Codman.



Fig. 12.

Is a clinical photograph showing the side of the growth which had broken down in places.



Fig. 12-a.

Radiogram showing lateral view of the growth—note superimposed patchy calcification in the region of the 1st metatarsal.



Fig. 13.

Is a clinical photograph showing the shape and side of growth in the thigh.





Fig. 10-b.  
The case after operation (excision).



Fig. 10-c.  
Recurrence of the growth after 6 months (back view).



Fig. 10-d.  
Recurrence of the growth after 6 months (front view).



Fig. 11.  
Clinical photograph of the growth in the lower end of the femur.



Fig. 16.

Is a clinical photograph showing the lateral view of the growth arising from right temple.

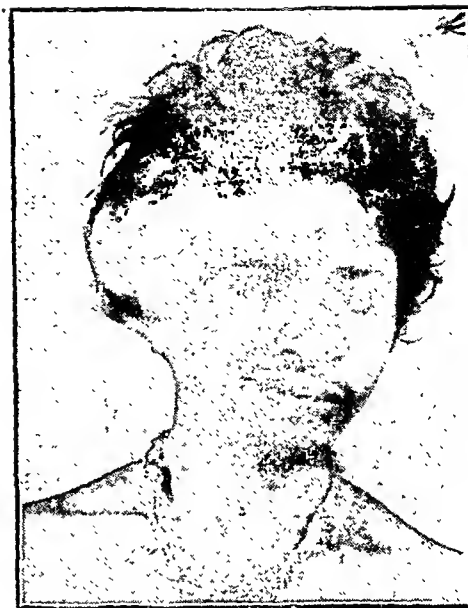


Fig. 16-a.

Anterior view of the growth from the right temple.

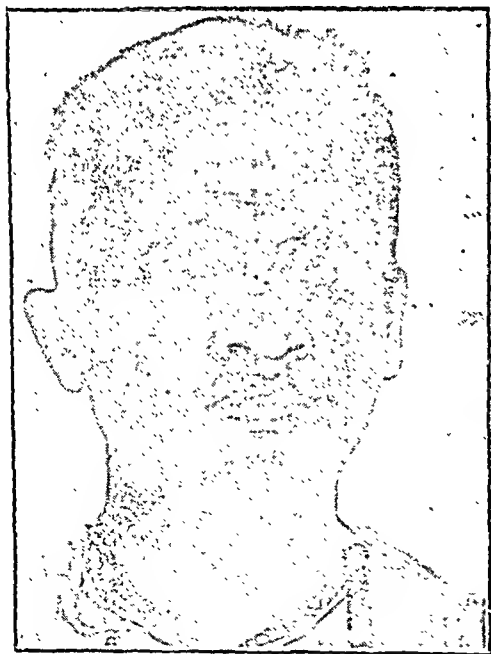


Fig. 16-b.

Showing recession of the growth after radiation.

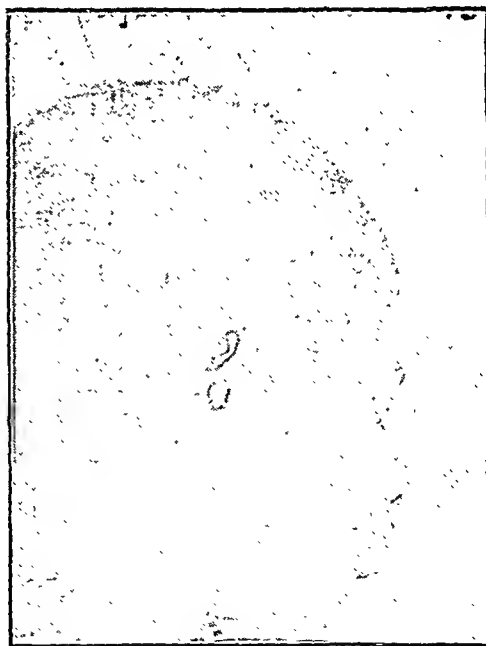


Fig. 16-c.

Lateral view showing the recession of the growth after radiation.



Fig. 16-d & 16-e.

Radiograms showing some periosteal reaction from the temporal aspect of the bone.

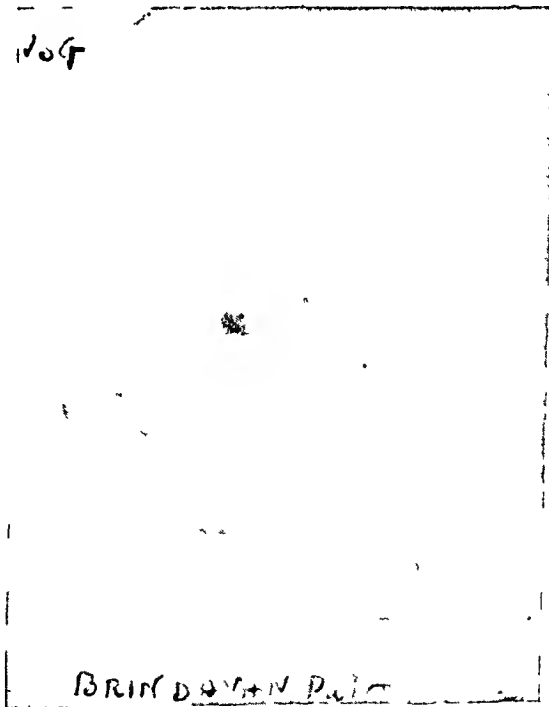
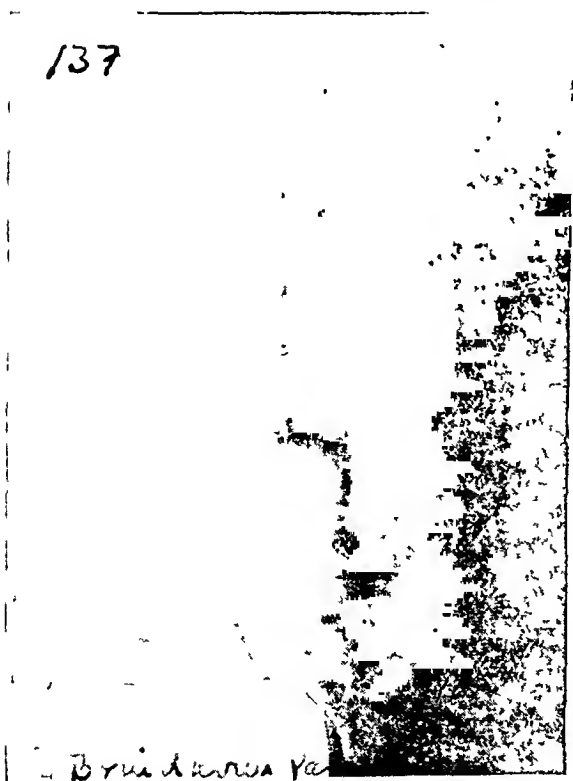


Fig. 16-f & 16-g.

Radiograms showing result after radiation.

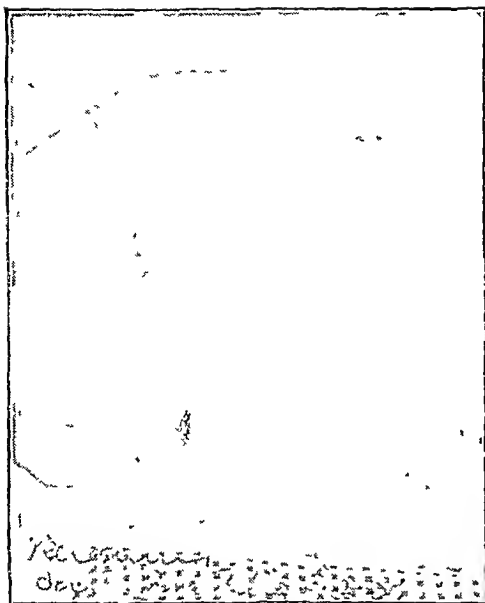


Fig 17.

Shows the recurrence of the growth at the site of incision made in the upper end of tibia.



Fig. 17-a.

Radiogram shows dense ossification in the upper end of the tibia with dense periosteal reaction.

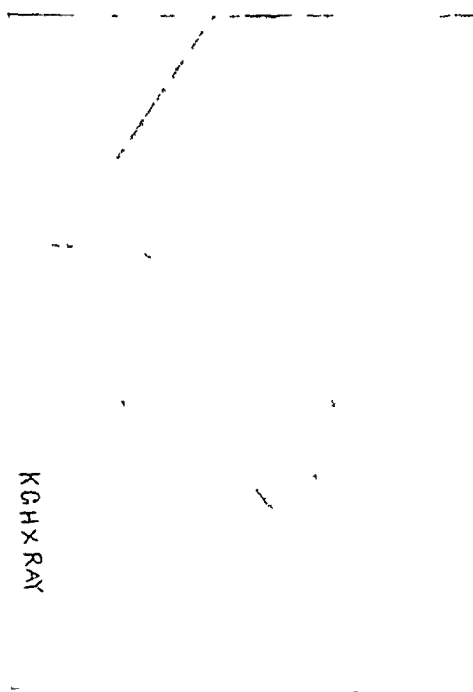


Fig 18

Radiogram showing destruction of the upper end of tibia with decalcification extending into the diaphysis of the tibia beyond the growth.

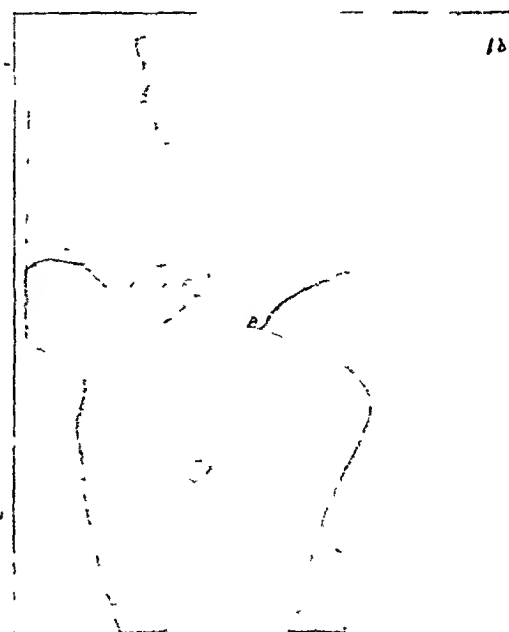


Fig. 18-a.

Clinical photograph—note the scars, result of thermal burns used for pain due to this tumour.

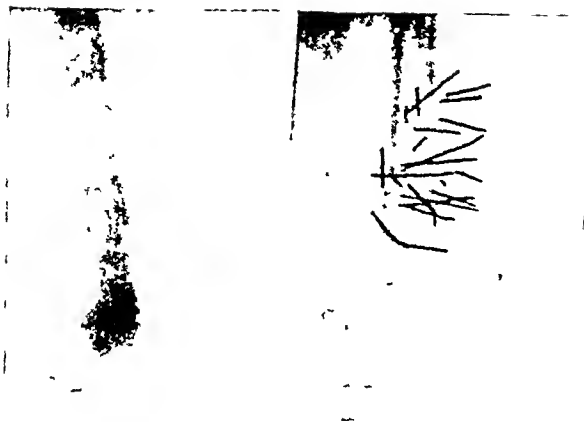


Fig. 19.

Radiograms showing the periosteal reaction with density in the medullary part of it and radium needles in situ.

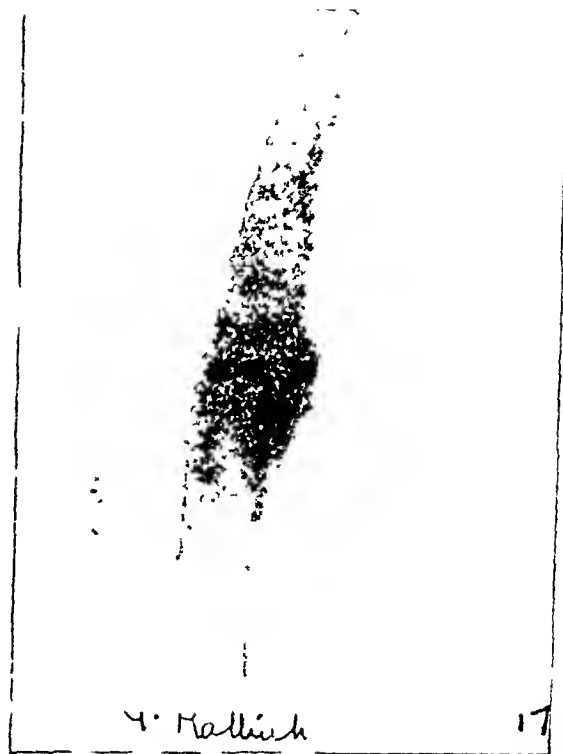


Fig. 20.

Shows a growth in the middle of the shaft of the femur with peculiar bony reaction at right angles to the shaft but with marked density in the compact and the medullary aspect of it.



Fig. 20-a  
A. P. view of the same.



Fig. 20-b.  
Clinical photo of the same.

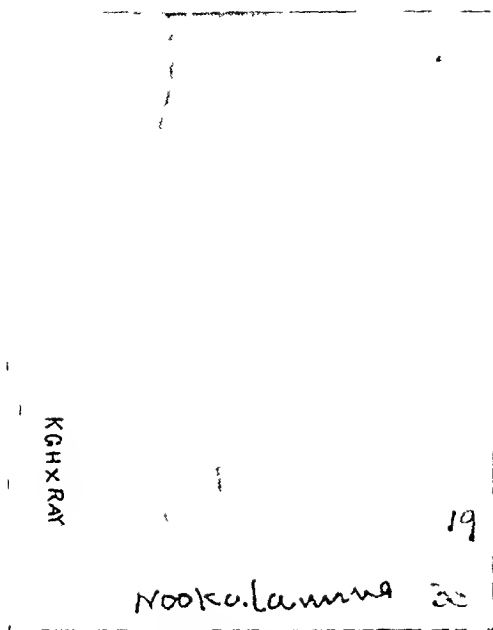


Fig 21.

Shows a growth arising from the upper end of the fibulá, rarefaction of the posterior aspect of the tibia in the compact area.

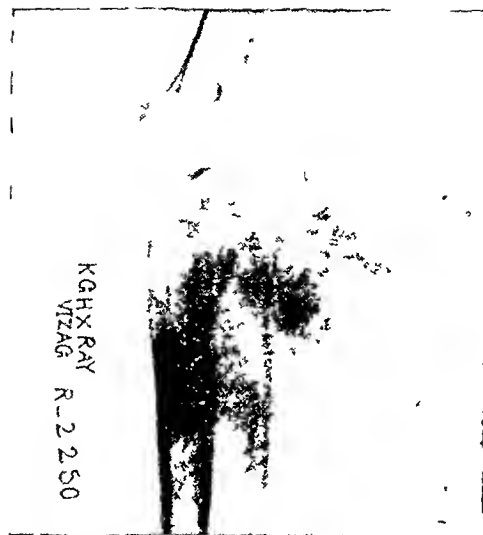


Fig 21-a

Lateral view of the same.

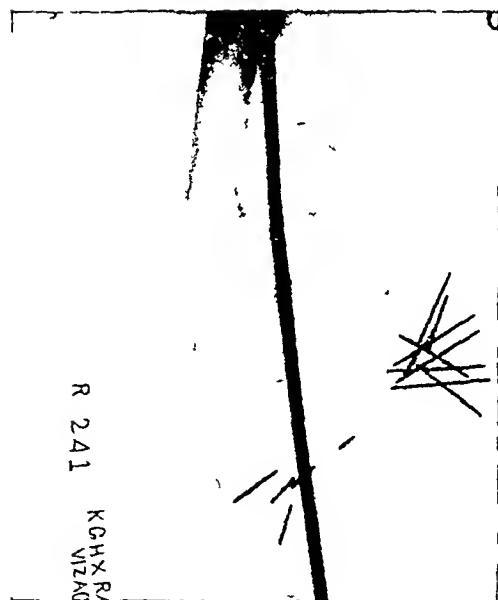
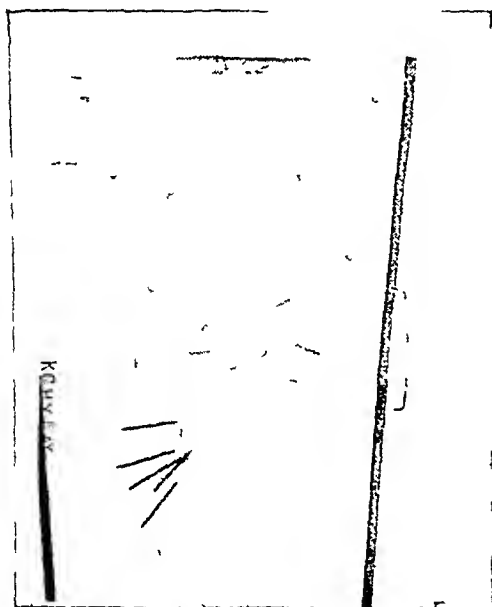


Fig 21-b & 21-c

Radium embedded in the growth

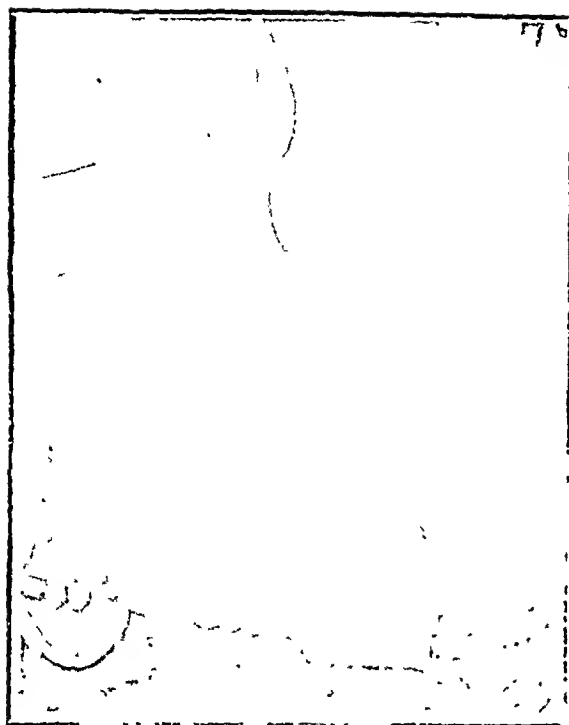


Fig. 21-d.  
Clinical photograph of the same.

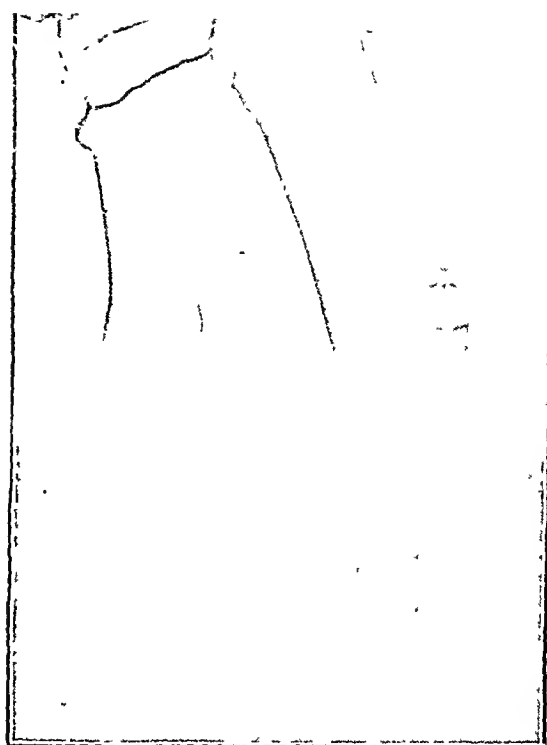


Fig. 22.

Is a clinical photograph showing the lateral view of the growth in the lower end of the femur with linear scars over the skin result of country thermal cautery used for relieving pain due to the disease.

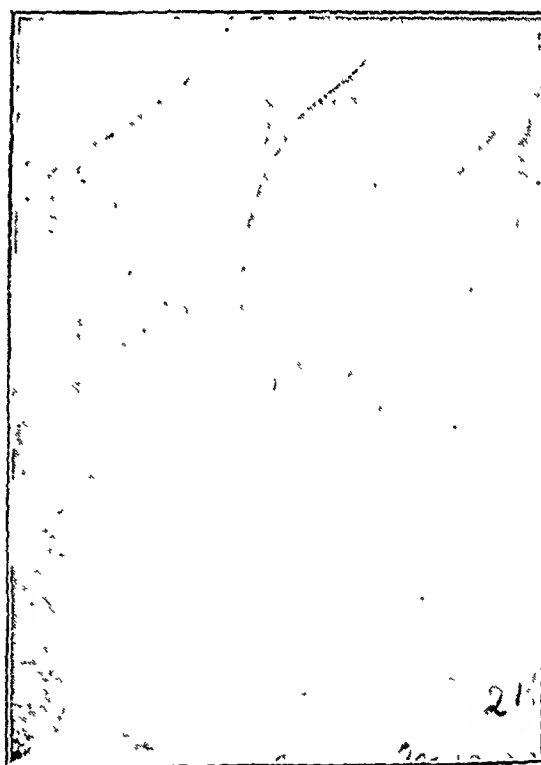


Fig. 23.

Clinical photo showing growth in the upper end of the tibia.

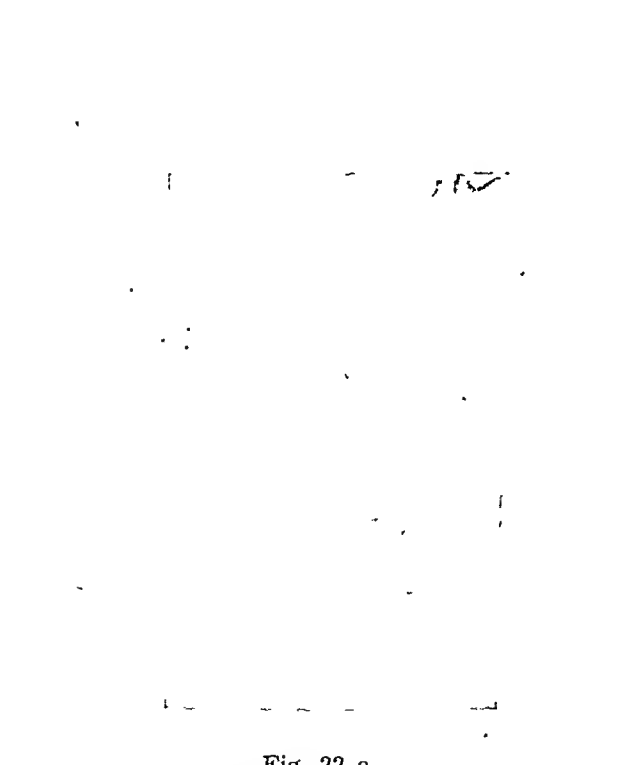


Fig. 22-a.

Radiogram—lateral view showing dense periosteal reaction with erosion of the trigone.

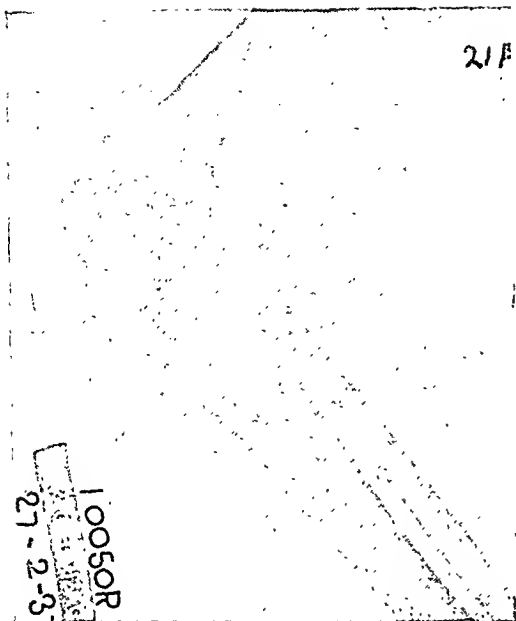


Fig. 23-a.

Radiogram showing the rarefaction in the upper end of the tibia.



Fig. 24.

A.P. and lateral views showing changes in the upper end of tibia with periosteal reaction.



Fig. 25.

Shows the growth in the ala of the ilium—note the mottled appearance.

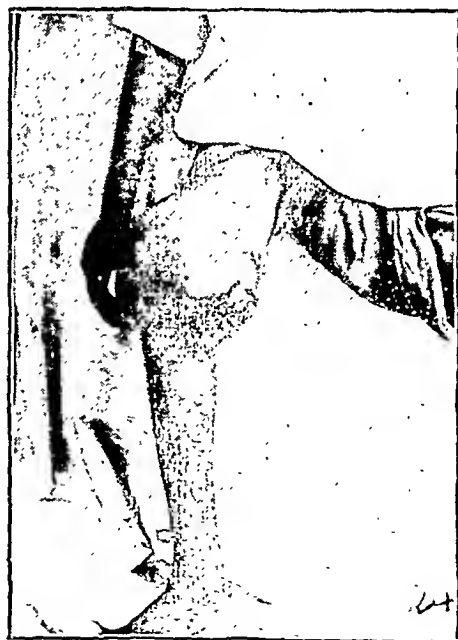


Fig. 26.

Is a clinical photograph showing a big sized growth of the lower end of the femur with fungation at one place with evidence of circular scars result of country thermo cautery.



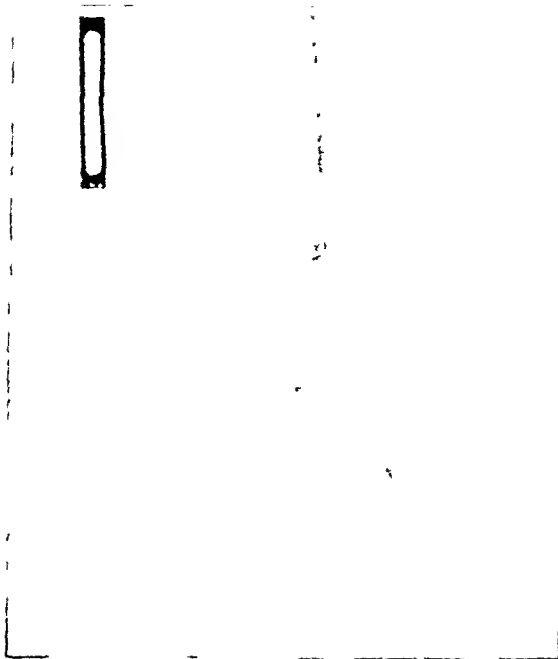


Fig 26-a

A.P. view showing destruction in the lower end of the femur with patchy calcification—note the changes in the diaphysis with decalcification beyond the growth.

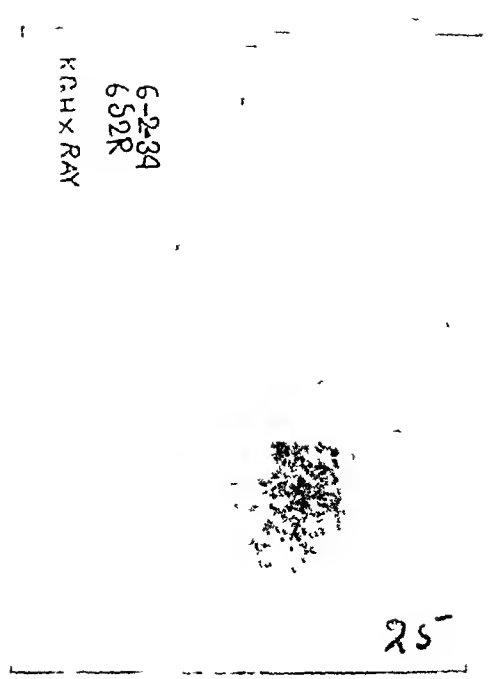


Fig 27.

Radiogram, lateral view showing calcification in a big growth arising from the ulna (? a case of calcification in a parosteal fibro-sarcoma).

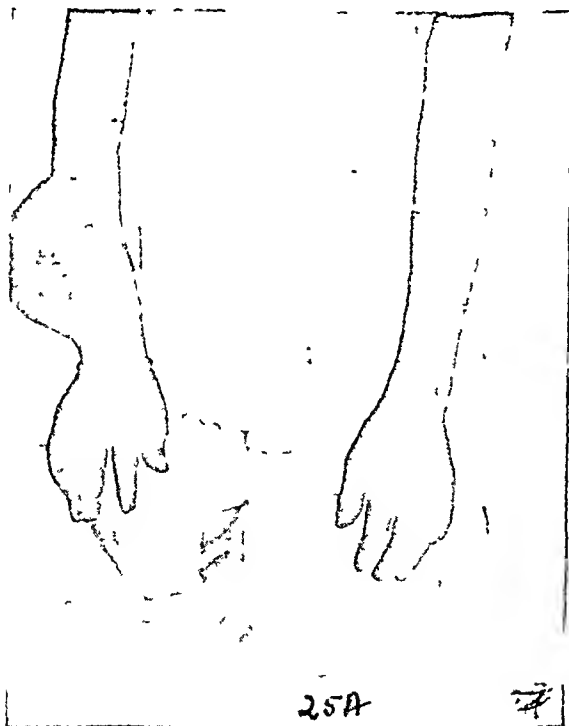


Fig. 27-a.

Is a clinical photograph showing the growth.



Fig. 28.

Radiogram showing an enormous growth arising from the radius—note the irregular patchy calcification.



Fig 29.

Clinical photo showing the growth in the upper end of the humerus.

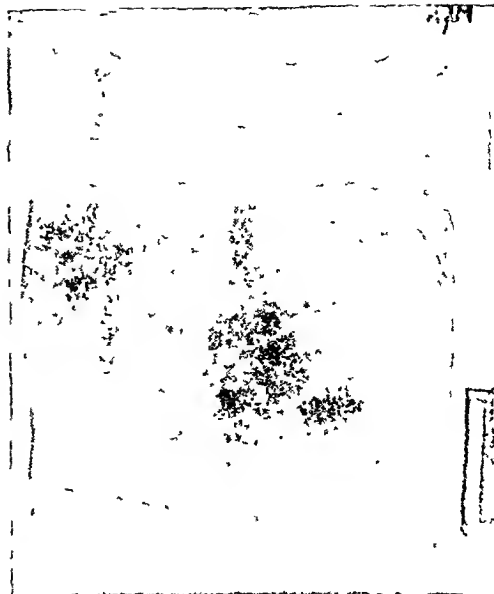


Fig. 29-a.

Radiogram showing deposits in the lungs.



Fig. 29-b.

Radiogram showing the destruction of the upper end with periosteal reaction—note the beaking.



Fig. 30.

Shows a scar which might have been an old operation scar with ulceration in an enormous growth in the upper end of the humerus

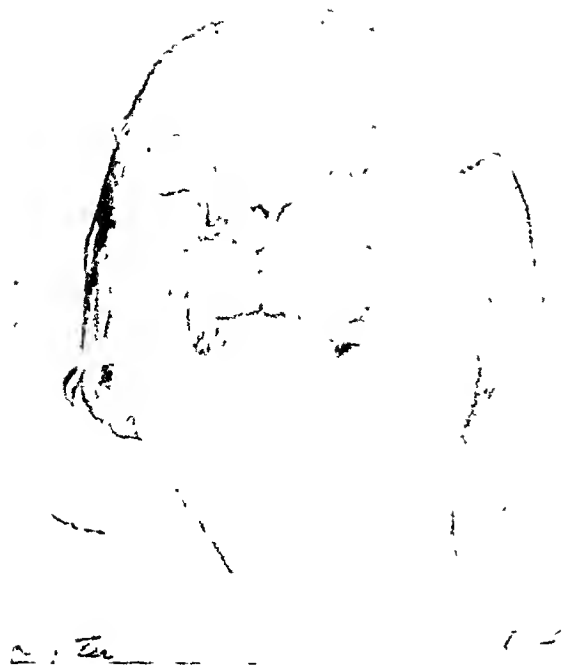


Fig. 31.

Shows the growth in relief after eversion of the upper lip on the left side.



Fig. 32.

Clinical photograph showing the growth between the thumb and the index finger.



Fig. 32-a.

A section clinical photograph of the growth removed.

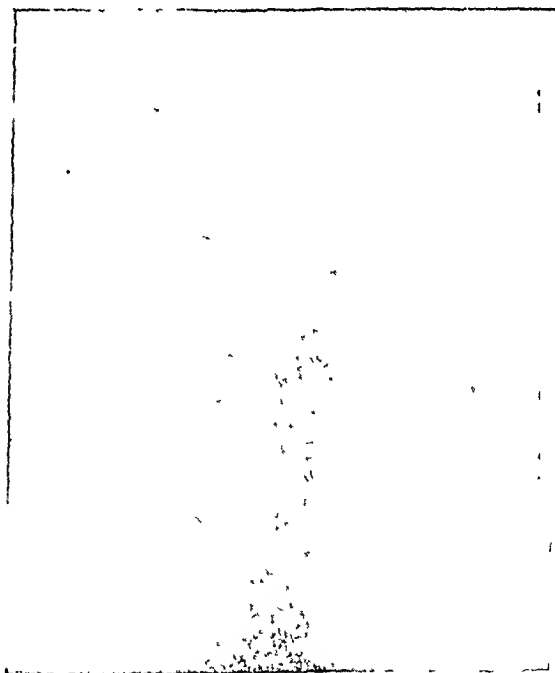


Fig. 33.

Radiogram of the whole aspect of the femur showing periosteal reaction with decalcification and the erosion of the cortex and beaking at the lower margin.

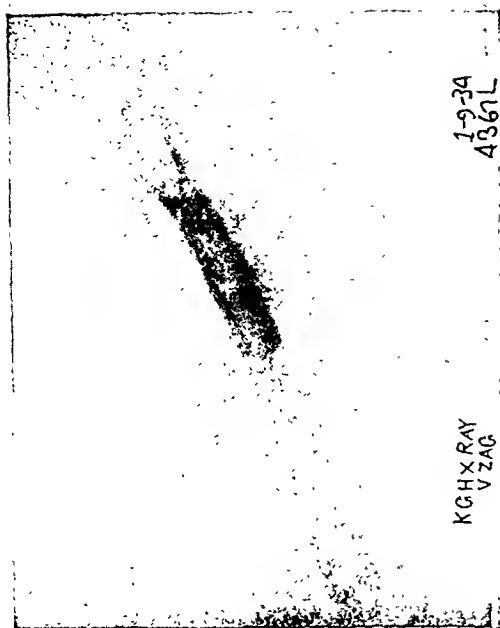


Fig. 33-a.  
Radiogram of the same case.

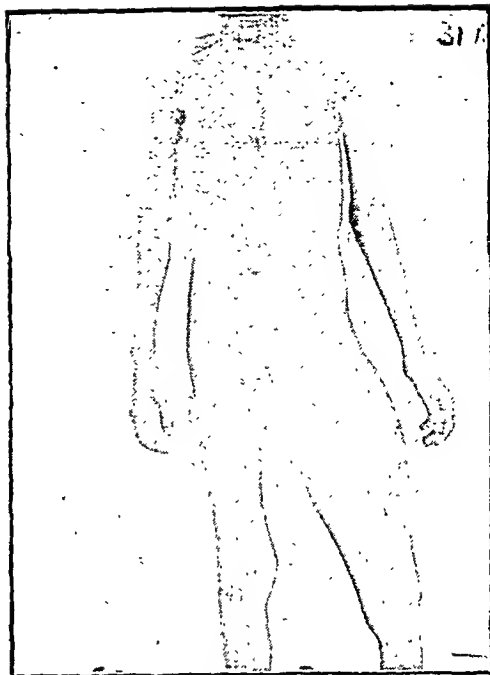


Fig. 33-b.  
Clinical photo of the thigh of the child.



Fig. 34.  
Radiogram showing the mottled appearance of the right side of the ilium.

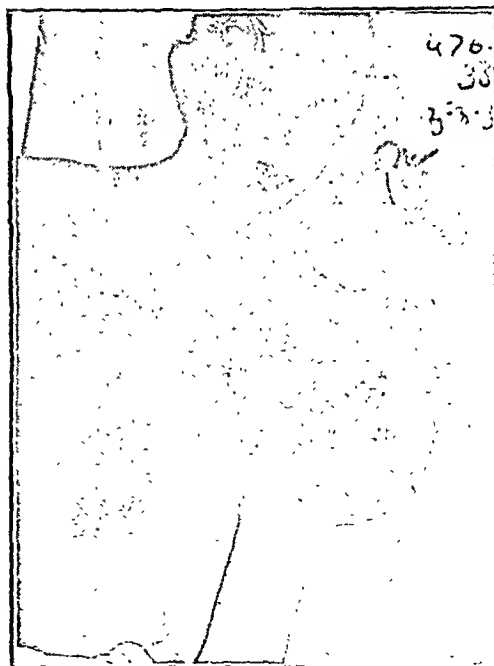


Fig. 35.  
Clinical photo of the growth.



Fig 36

Clinical photo of the growth of the upper end of the humerus.

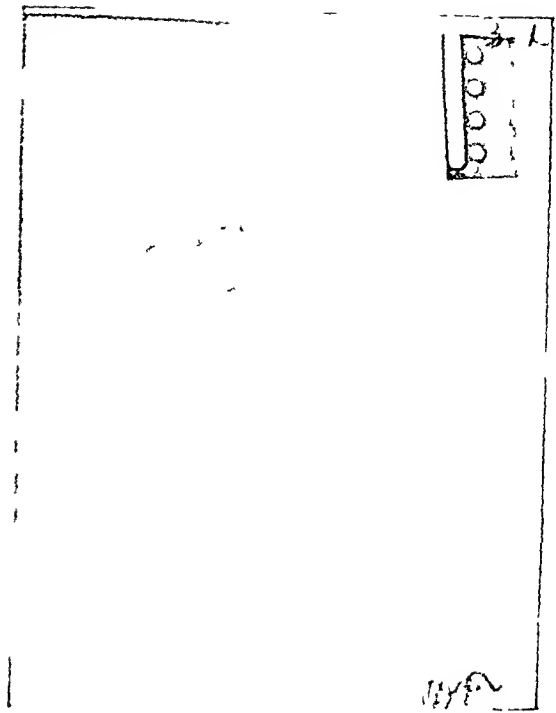


Fig. 37-b.

Is a radiogram showing a large irregularly oval rarefaction of the ala of the ilium.

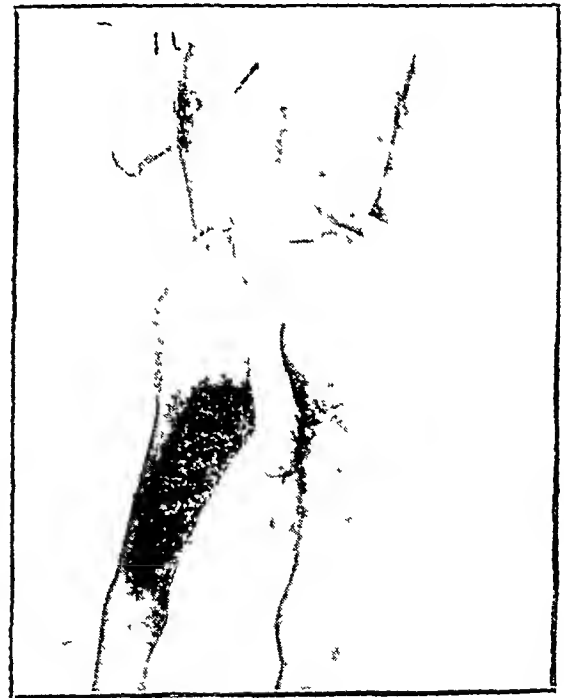
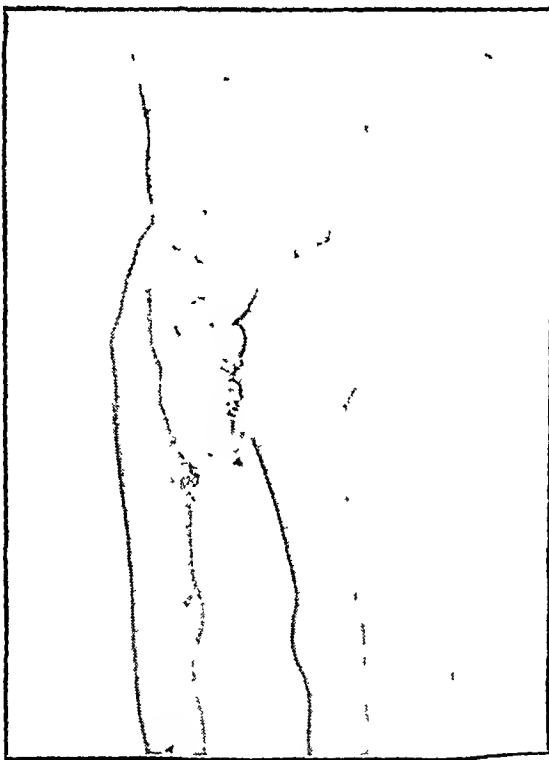


Fig. 37 & 37-a

Anterio lateral and posterior view of the growth arising from the ilium.

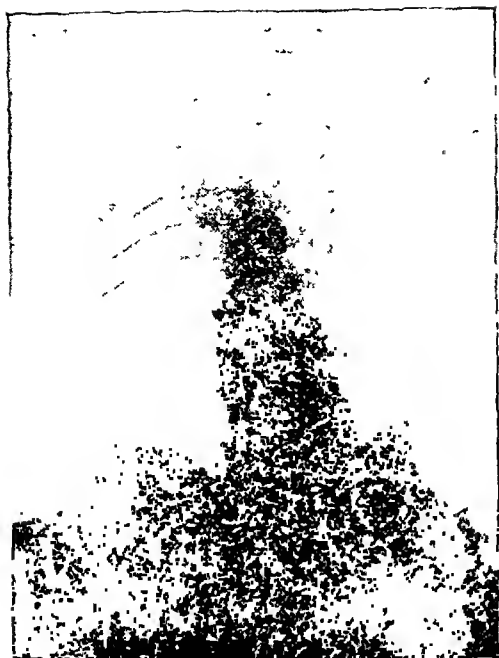


Fig. 38.  
Shows secondary deposits in the lung.

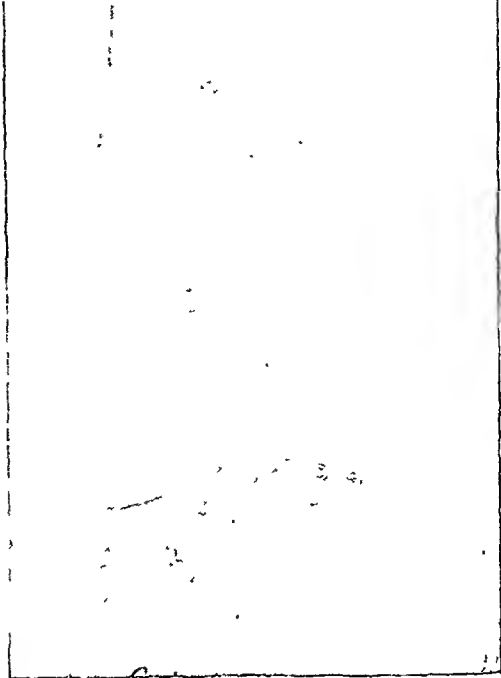


Fig. 39.  
Radiogram showing the rarefaction in the middle of the lower end of the metaphysis of the femur.

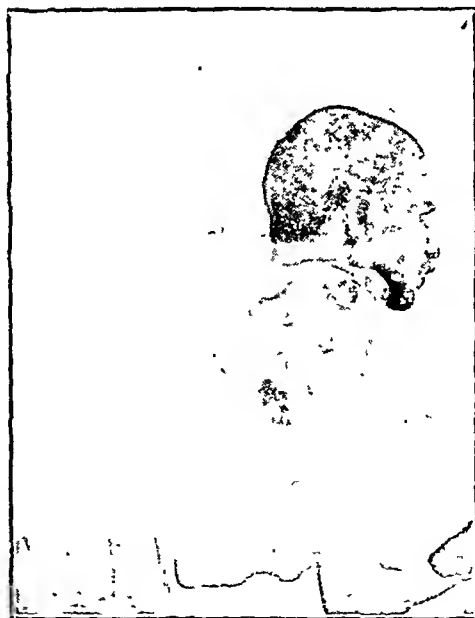
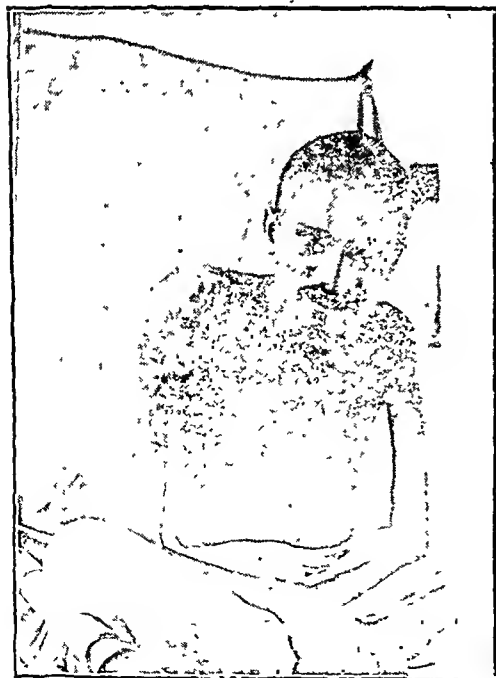


Fig. 38-a & 38-b.

are clinical photographs showing the ulceration of the growth and protrusion of the growth through the incision done mistaking it to be an abscess.

CHINNAPPA

30A

Fig 39-a

Radiogram showing the rarefaction in the middle and central aspect of the lower end of the femur.

CHINNAPPA

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Fig 39-b.

Shows rarefaction distinctly in the diaphysis of the lower end of the femur—lateral view.

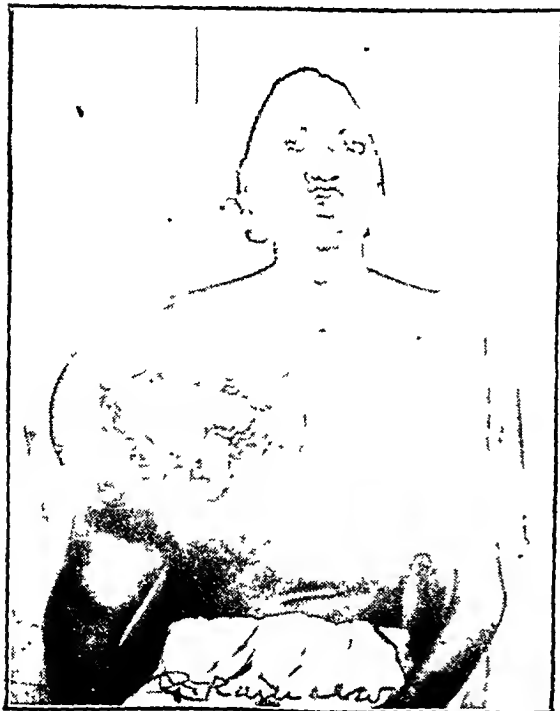


Fig 40.

Clinical photograph of a very big growth of the upper end of the humerus.

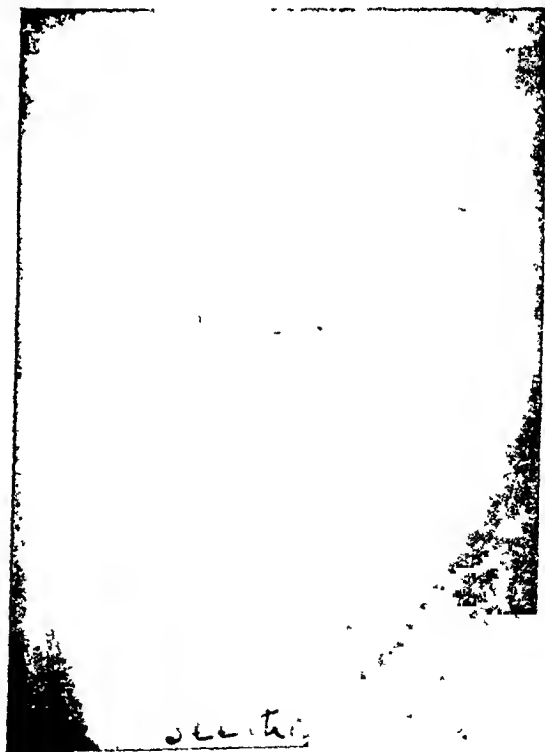


Fig. 41.

Radiogram showing the growth on the lateral aspect of the lower end of the femur with slight periosteal reaction below and showing the beaking above.

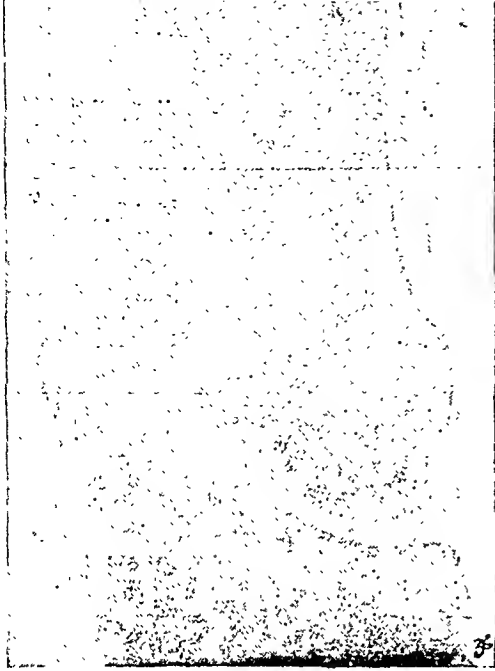


Fig. 42.

Shows the growth—rarefaction in the lower end of the femur, medial aspect.



Fig. 43.

Radiograms showing the growth springing from the wing of the scapula—note the rarefaction.



Fig. 44.

Clinical photograph of growth from the upper end of the humerus.

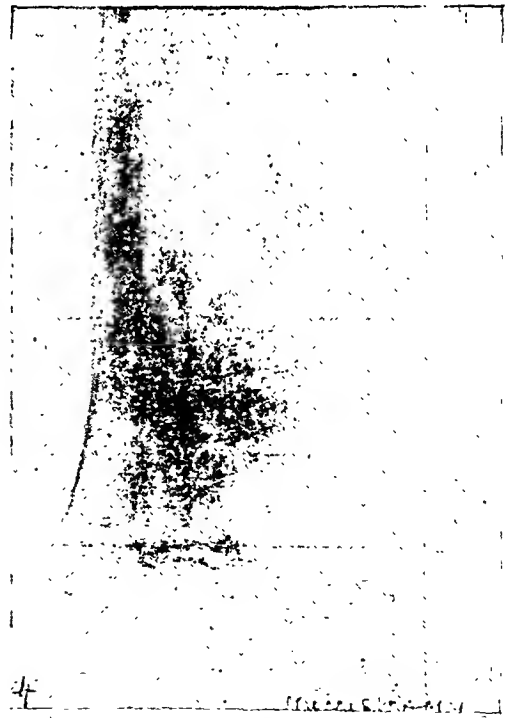


Fig. 45.

Showing intense osteolysis of the diaphysis of the lower end of the femur with lifting of the periosteum as a ledge of bone.



# OSTEOGENIC SARCOMA

Serial No.	Name	Age & Sex	Duration	History	Bone and site and x-ray findings	Pathology report and investigations	Treatment	Result
1	Subhadramma Fig. 6.	20 yrs. H. F.	3 months	Started as a swelling, mistaken for an abscess and incised, since then bleeding from the wound at intervals.	Sarcoma, upper end of tibia with secondaries in left humerus & lungs.	After amputation--Osteogenic sarcoma.	Amputation, thigh, at the junction of middle and lower third to relieve the smell and bleeding.	Died at home 3 months later due to secondaries in humerus and lungs.
2	Chinnayya	25 yrs. H. M.	1 year.	Started with pain first and later the swelling appeared. No trauma, general condition poor (sarcoma upper end of right tibia).	Upper end of tibia shows a growth with fine irregular trabeculation with no demarkation in the diaphysis below and metaphysis above.	No biopsy done.	Radium insertion--total irradiation 6721 mgm hours.	Discharged otherwise.
3	K. Ramaswami Fig. 7 & 7a	60 yrs. H. M.	6 months.	Started as a small painful swelling which gradually increased in size.	Tumour affecting the lower end of right femur, pathological fracture of shaft of the bone, marked new bone formation in a radiating manner.	Post-mortem Osteogenic sarcoma.	P. M. Cause of death--Osteogenic sarcoma with secondary dissemination in lungs and brain.	Died
4	J. Paramma Fig. 8 & 8a	18 yrs. H. F.	6 months.	Started as a swelling, small, painful, upper end of right arm.	Destruction of the upper and middle third of the shaft of right humerus with new bone formation, periosteal in type with dense new bone formation extending almost to junction of middle and lower third.	Biopsy done but result negative.	Exploration -- only blood was drawn.	Discharged otherwise-- Result not known.
5	M. Suri Fig. 9, 9a & 9b	15 yrs. H. M.	6 months. Iliac; 2 months L shoulder 15 days L temple.	Started as a painful swelling in the Left buttock followed by a swelling in the region of the right shoulder and later a swelling in the right temple.	Osteogenic sarcoma of right iliac bone and right humerus, secondaries on right side of skull. <i>Note:</i> characteristic features (Iliac and humerus pictures are reversed while printing.)	Calcium 9.7 mg. per 100 c.c. serum; specimen of bone lost but skull kept in museum. P. M. Osteogenic sarcoma.	Interstitial radiation, 5689 mgm hrs. in the iliac bone; the swelling subsided but in the shoulder the swelling began to increase. This was done to try if tumour was radiosensitive.	Died: P. M. Large tumour in left ilium, metastasis in Rt. humerus & cranium. Lungs, kidney congested. Fatty degeneration of liver.

6	K. Appanna Fig. 10, 10a, 10b, 10c & 10d	18 yrs. H. M.	1½ months.	Started a small swelling over inferior angle of right scapula which grew gradually, pain 12 days	Sarcoma, scapula, right.	W. R. + + After excision osteogenic sarcoma.	Excision of the tumour.	Osteogenic sarcoma histologically. Relieved—re-admitted 7 months later with recurrence over shoulder, thigh & pelvis; discharged otherwise as inoperable. Re-admitted again 2 mths. later with retention of urine—Died.
7	S Chinnayya Fig. 11 & 11a	18 yrs. H. M.	6 months.	Pain and swelling, right knee, increasing in severity.	Osteogenic sarcoma, lower third of right femur with typical sun-ray appearance.	Biopsy not done.	Advised amputation but refused.	Discharged otherwise—result not known.
8	Rajeswaramma	16 yrs. H. F.	1½ months.	Pain and swelling over the upper end of right tibia	Rt. tibia—x-ray shows rarefaction in centre with faint thin bone deposit parallel with the cortex.	W. R. + + Biopsy: The cytology architecture is that of an endotheliomatous tumour sheets of polyhedral cells with rounded nuclei & scanty poorly staining cytoplasm without appreciable intercellular substance.	Tumour explored with a Trephine and closed. Deep X-rays.	Discharged otherwise; Advised to go to G. H. for deep x-rays. Reported died 3 months later. Had deep x-ray therapy.
9	N. Appanna Fig. 12 & 12a	50 yrs. H. M.	2 months.	20 years a small growth between great and second toe; suddenly increased in size which ulcerated; Fungating Chondrosarcoma, foot, left.	Diffuse ossification over the whole of the mass and seems to arise from the head of the 1st metatarsal bone, right.	P. M. Ossifying chondro-sarcoma 1st metatarsal bone; had a duodenal diverticulum near ampulla of Vater.	Inoperable.	Died: Developed hemiplegia with gangrene foot & phlebitis 7 days after admission. P. M. done.
10	Seshamma Fig. 13 13a	16 yrs. H. F.	6 months	Painful swelling, right thigh.	Periosteal sarcoma, right femur, extending the whole length of right femur, typical sun-ray appearance.	Biopsy not done.	Advised disarticulation at hip, but refused.	Discharged otherwise, follow up, no reply.

# OSTEOGENIC SARCOMA (Contd.)

Serial No.	Name	Age & Sex	Duration	History	Bone and site and x-ray findings	Pathology report and investigations	Treatment	Result
11	M. Guruvagadu Fig. 14	25 yrs. H. M.	7 months.	Pain in the knee.	Osteolytic type of sarcoma, upper end of left tibia showing replacement of bony structure by tumour mass.	Biopsy not done.	Advised amputation but refused.	Discharged otherwise—follow up, no reply.
12	R. Seetharamamma Fig. 15 & 15a	15 yrs. H. F.	1½ months.	Started as a painful swelling on the medial side of the left knee which gradually increased in size, was cauterised.	Sarcoma, upper end of left tibia—Chest heart—dilated and boot shaped.	W. R. Negative Biopsy not done.	Advised amputation but refused.	Discharged otherwise—follow up, no reply.
13	Brindavan Patro Fig. 16, 16a, 16b, 16c, 16d, 16e, 16f & 16g	25 yrs H. M.	2 years.	Started as a swelling which gradually increased in size; diminution of vision and hearing, right eye and ear, 2 months.	Skull shows fluffy appearance.	Biopsy not done.	Interstitial radiation. 1526 mgm. hours of radium given—at time of discharge growth showed signs of regression and became flat.	Follow up—no reply.
14	Veeranna Fig. 17 & 17a	20 yrs. H. M.	1 year.	Started as a painful swelling of the left knee following trauma; operated at Cocanada, swelling was removed; 6 months later it recurred.	Upper end of left tibia.	W. R. doubtful; Path: Chondrosarcoma showing typical cartilaginous nodules with large hyperchromatic cartilage cells.	Amputation, thigh junction of upper and middle third.	Relieved—no reply on follow up.
15	Chennamma Fig 18 & 18a	20 yrs. H. F.	6 months.	Started with pain in right knee and later swelling, no trauma.	Upper end of right tibia.	Biopsy not done.	Refused amputation.	Discharged otherwise—no reply on follow up.
16	Ranganayakamma Fig. 19	16 yrs. H. F.	3 months.	Pain in the left knee increasing in severity 3 months.	Shows parallel patchy lamination suspicious of Ewings or Specific infection; had antisyphilitic treatment but no result.	W. R. Strong + Biopsy not done.	12 radium needle inserted into the bone after drilling (6620 mgm. hours) 12 needles into periosteum. Total 53 mgm. 8880 mgm. hours.	Relieved; Reported died of same disease 2 years later, 6 months after giving birth to a son. This boy is all right now.

17	Malliah Fig. 20 & 20a	22 yrs. H. M.	4 months.	Started with pain, lower part of thigh, right, followed by swelling and increasing pain.	Medulla shows in places cavitation lack of differentiation between cortex and medulla in the middle of the shaft of right femur, parallel laminations with periosteal, sun-ray appearance, suggestive of Ewing's sarcoma; No secondaries in lung, no other bones showed clinical evidence of deposits.	W. R. Negative. Aspiration biopsy—blood clot with shreds of tissue having the structure of a round cell sarcoma.	Exploratory puncture, blood stained fluid drawn which clotted without separation of serum. Another specimen contained whitish flakes. Advised amputation as there was not enough radium or x-ray treatment	Discharged otherwise—no reply to follow up.
18	Appanna	30 yrs. H. M.	3 months	Started with pain and swelling in the left knee joint.	There is periosteal separation being posteriorly and new bone formation; In the lateral view spicules of bone run into the soft tissues surrounding the bone. Periosteal sarcoma left lower end of femur Lungs: No definite evidence of secondaries in the lungs. Soft deposits in and around the right hilum.	Biopsy not done.	Advised amputation but refused.	Discharged otherwise—no reply to follow up
19	Nookalamma Fig. 21, 21a, 21b, 21c & 21d	40 yrs. H. M.	6 months.	Pain and swelling, right knee.	Right fibula shows erosion of cortex. Upper end of tibia show similar changes posterior aspect with evidence of new bone formation.	W. R. Negative Biopsy not done.	Radium implantation 9656 mgm. hours, result good at time of discharge.	Relieved—no reply.
20	Sundula Fig. 22 & 22a	25 yrs. H. M.	2 months	Started as painful swelling on the lateral side, left knee joint.	Erosion of Trigonal area of femur with beaking; new bone formation in front and lateral aspect	W. R. Negative Biopsy not done.	Advised disarticulation but refused.	Discharged otherwise.
21	Seshachalam Fig. 23 & 23a	28 yrs. H. F.	3 months.	Started as a painful swelling on the medial aspect of right knee after parturition; subsided after local treatment.	Osteolytic changes of right upper end of tibia, lateral aspect. Lungs: no secondaries.	Biopsy not done.	Advised amputation but refused.	Discharged otherwise—no reply on follow up.

# OSTEOGENIC SARCOMA (Contd.)

Serial No.	Name	Age & Sex	Duration	History	Bone and site and x-ray findings	Pathology report and investigations	Treatment	Result
22	P. Chinnamma Fig 24	30 yrs. H. F.	6 months	Swelling and pain, right knee one month after trauma.	Osteolytic changes upper end of right tibia with extension into shaft below. Note patchy bone formation outside cortex.	Biopsy not done.	Advised amputation but refused.	Discharged otherwise, result not known -- letter returned by D.L.O.
23	Janakiramayya Fig. 25	23 yrs. H. M.	1 year	Pain and swelling in the right iliac region shooting down the thigh and leg on the posterior aspect.	Sarcoma, right ilium involving the sacrum, secondary deposits in lungs.	Biopsy not done.	Inoperable.	Discharged otherwise, result not known -- letter returned by D.L.O.
24	Veeraswamy Fig 26 & 26a	35 yrs. H. M.	10 months	Started with pain, right knee following a sprain. One month later swelling appeared. It was branded by a native doctor resulting in ulceration	Sarcoma, femur -- shows osteolytic changes with irregular ossification.	W. R. Doubtful No biopsy done.	Advised amputation but refused.	Discharged otherwise, result not known -- letter returned by D.L.O.
25	Veeri Naidu Fig 27 & 27a	25 yrs. H. M.	1 year	Pain and swelling over the dorsum of right fore-arm following trauma.	Irregular patchy bone deposits in a big tumour formation, seeming to arise from right ulna but showing involvement of shaft of radius also.	Biopsy not done.	Refused treatment.	Discharged otherwise, result not known
26	Bangaramma Fig. 28	25 yrs. H. F.	1 year	Started as a painful swelling fore-arm which ulcerated about three months ago.	Periosteal sarcoma radius sun-ray appearance seen.	Biopsy not done.	Refused treatment.	Discharged otherwise, result not known
27	K. Narasi Reddi Fig. 29, 29a & 29b	20 yrs. H. M.	5 months	Pain over the upper third of left humerus and swelling 2 months; haemoptysis 2 months.	Periosteal sarcoma, upper end of humerus; Lungs: marked secondary deposits right plura and lung, secondary deposits, left lung.	Biopsy not done.	Inoperable.	Discharged otherwise, Reported dead one month. after discharge

28	K Malleu Fig. 30	14 yrs. H. M.	3 months.	Pain and swelling, left shoulder.	Periosteal sarcoma, upper end of left humerus with marked beaking.	Biopsy not done.	Inoperable.	Discharged otherwise—result not known.
29	R. Sundari Fig. 31	25 yrs. H. F.	1 year.	Started as a small nodule near the upper alveolar margin.	Maxillary antrum on left side opaque, sarcoma, maxillary, left.	W. R. Negative Biopsy after excision—osteogenic sarcoma.	Radium implantation 15 mg. 1725 mgm. hours—no effect; later excision done.	Discharged relieved—Result of follow up—letter returned by D. L. O.
30	Pirji Reddy Fig. 3' & 32a	35 yrs. H. M.	1 year.	Swelling started between index and thumb, grew to the size, painful and tender, was branded.	X-ray shows 2nd metacarpal entirely replaced by tumour tissue.	Biopsy not done—Pathology report —Myxo chondro sarcoma after amputation.	Amputated.	Follow up—alive after one year.
31	Sabavarappu Devudu Fig. 33, 33a & 33b	7 yrs. H. M.	2 years.	History of trauma with increasing swelling.	Appearances suggestive of periosteal sarcoma, shaft of femur, left.	Biopsy—only blood drawn.	Refused disarticulation.	Discharged otherwise—result not known.
32	G Satyanarayana Fig. 34	56 yrs. H. M.	9 months.	Pain in hip—limitation of flexion.	Osteogenic sarcoma, ilium.	Biopsy not done.	Poor condition.	Discharged otherwise.
33	Bangariah Fig. 35	20 yrs. H. M.	6 months.	Pain and swelling, left shoulder	Osteogenic sarcoma, upper end of left humerus	Biopsy not done.	Poor condition.	Discharged otherwise.
34	Chinnayamma Fig. 36	25 yrs. H. F.	6 months.	Swelling, shoulder, 6 months duration.	X-ray not taken. Upper end of humerus.	Biopsy not done.	Advanced case.	Discharged otherwise.
35	Latchayya Fig. 37, 37a & 37b	50 yrs. H. M.	9 months.	Pain in the region of left hip.	X-ray shows osteolytic type of sarcoma, ilium, left.	Biopsy not done.	Poor condition.	Discharged otherwise.
36	Ramiah	30 yrs. H. M.	6 months.	Painful swelling, right upper end of tibia.	Osteolytic type of sarcoma of right upper end of tibia.	Biopsy not done.	Radiation—refused amputation.	Result poor—discharged otherwise.
37	Sundara Row Fig. 38, 38a & 38b	23 yrs. H. M.	3 months.	Six weeks back had an accident, later pain, had electric massage, later incised in a Hospital with increase in swelling, pain and smell.	X-ray shows osteolytic sarcoma of spine and acromian process of right scapula with secondaries in lung.	Biopsy not done.	Inoperable.	Discharged otherwise—result not known.
38	Chinnappan Fig. 39, 39a & 39b	20 yrs. H. M.	3 months.	Pain in the left knee following trauma, 3 months ago.	Osteolytic sarcoma, lower end of left femur.	Aspiration biopsy—only blood clot and fibrin.	Pre-operative x-ray therapy.	Discharged otherwise result not known.

# OSTEOGENIC SARCOMA (Contd.)

Serial No.	Name	Age & Sex	Duration	History	Bone and site and x-ray findings	Pathology report and investigation	Treatment	Result
39	R. Ramaswamy Fig. 40	18 yrs. H. M.	6 months	For pain in shoulder with swelling which began to increase after country thermo cautery.	Clinical photo presented. X-rays were not taken. Sarcoma, humerus, right.	Biopsy not done.	Nil.	Discharged otherwise as it was an advanced case of sarcoma—result not known.
40	Seetharamamma Fig. 41	18 yrs. H. F.	6 months.	Painful swelling, left knee, medial aspect of thigh, massaged for 1 month. Another swelling over left temple of the size of an egg, 20 days duration.	Appearance suggestive of osteogenic sarcoma, Left femur, lower end.	Aspiration biopsytive. Osteogenic sarcoma.	Advised amputation but refused.	Discharged otherwise—result not known.
41	Gopal Rao Fig. 42	21 yrs. H. M.	25 days.	Pain in the right knee, no definite history of trauma, effusion.	Osteogenic sarcoma, lower end of right femur, erosion of cortex with decalcification with pathological fracture.	Aspiration biopsy; shows collection of spheroidal shaped cells and a few malignant round cells with blood clot suggestive of osteogenic sarcoma.	Refused amputation.	Discharged otherwise—reported dead 6 months later.
42	Satyanaarayana Fig. 43	30 yrs. H. M.	9 months.	Started as a small swelling in the region of left shoulder.	Left scapula (No. 5311 dated 28-11-1946).	Aspiration biopsy—appearance suggestive of Ewing's sarcoma.	Deep x-ray therapy given	Discharged otherwise.
43	Raja Narasimha Rao Fig. 44	32 yrs. H. M.	3 months	Painful swelling, right shoulder.	Appearance suggestive of osteogenic sarcoma of right humerus, upper third.	Biopsy not done.	Deep x-ray therapy.	Not much improved—result not known.
44	Munuswamy Fig. 45	21 yrs. H. M.	3 months.	Pain in the left knee following trauma.	Osteogenic sarcoma, lower end of femur, left.	Aspiration biopsy unsuccessful.	Advised amputation.	Discharged otherwise—result not known.

45	Lalitha	15 yrs. H. F.	2 months.	Started with pain and effusion in left knee joint.	Outer table of cortex of the lower end of left femur eroded, new bone formation + +; appearance suggestive of osteogenic sarcoma. Lungs—small rounded opacities suggestive of secondaries.	Biopsy not done.	Inoperable.	Discharged otherwise—result n known.
46	Manickkam	21 yrs. H. M.	6 months.	Pain and swelling round knee and lower end of thigh.	Femur, left (No. 2130 dated 28-11-1946).	Aspiration biopsy shows groups of pleomorphic cells polyhedral and spindle shaped and a few large single giant cells hyperchromatic and plenty of intercellular material suggestive of osteogenic sarcoma.	Advised amputation but refused.	Discharged otherwise.
47	Srinivasan	25 yrs. H. M.	23 days.	History of injury 2 years ago, pain 23 days ago, acute pain and swelling upper end of left tibia.	X-ray appearance—suggestive of osteogenic sarcoma, upper end of left tibia.	Aspiration biopsy suggestive of osteogenic sarcoma.	Advised amputation but refused	Discharged otherwise—result not known.
48	E. Appanna	30 yrs. H. F.	6 months.	Started as a small swelling on the middle phalanx of the middle finger, left and gradually grew to the size of an almond.	Chondro sarcoma, finger. There is destruction of bone suggestive of sarcomatous change.	After amputation Chondro sarcoma.	Amputation of left middle finger.	Good at time of discharge—follow up—result not known.
49	Venkateswaralu	17 yrs. H. M.	4 months.	History of trauma 4 months ago, since then unable to use his left knee.	Secondaries are visualised in the lung field.	Osteogenic sarcoma, lower end of left femur.	Amputation through the upper third of thigh.	Relieved—No reply to letter.



## OSTEOCLASTOMA

Seventeen proved cases of osteoclastoma are reviewed. The cases that came for diagnosis and treatment were definitely more but are not reported as some did not consent for any further investigation and treatment. Such cases have been excluded from this paper. Only clinical, radiological and therapeutic aspects are dealt with.

### AGE INCIDENCE AND DURATION

The age incidence as noted was between the years of 35 and 40 except in cases where this occurred in the small long bones, i.e., the metacarpals, metatarsals and phalanges. In these situations it occurred in younger people.

The duration in all cases was long, usually over six months. Sometimes it was difficult to get a correct assessment of the duration due to illiteracy of the public. Sometimes growths which occurred in younger people, in the situations mentioned above, grew more rapidly and hence the patients came to the surgeon earlier.

### RELATION OF TRAUMA TO TUMOUR

A very curious feature about these bone tumours is the relation of the trauma to the tumour. 12 out of the 17 cases gave a definite history of injury prior to the onset of swelling or pain. In the case of Osteoclastoma of the sacrum (case No. 6) the patient definitely gave a history of a fall from his bicycle landing on his buttocks and due to the pain he was X-rayed to exclude a possible fracture in the region of the sacrum which was negatived.

### DIFFICULTIES IN DIAGNOSIS

It is difficult to diagnose osteoclastoma in the earlier stages. Sometimes a history of a previous accident with subsequent pain makes them seek the advice of a doctor or these growths are accidentally discovered after a roentgenography when they come for pain or a swelling. In atypical borderline types of cases, it becomes a difficult

problem. A comprehensive review has to be taken after doing specialist types of investigations such as x-ray, blood and biochemical examinations and aspiration and incision, or aspiration or trephine (Turek Trephine) biopsy as a routine before arriving at a diagnosis.

### ATYPICAL CASES SHOWING DIFFICULTY IN DIAGNOSIS

The following cases show that we cannot solely depend on radiography for diagnosis :

1. A Christian girl aged 16 years with a fusiform type of tumour extending from the upper third to the junction of the middle and lower third of the shaft of the humerus on the left side was admitted. X-ray appearance was suggestive of osteoclastoma; aspiration biopsy was negative. On removal, the pathologist's report was Osteitis Fibrosa Cystica. Her blood calcium was within normal limits and no enlargement of parathyroid was felt and no exploration was done and she is under observation after excision and bone graft operation. (Fig. 46 & 46-a.)

2. A Christian, male, a law student, aged 26 years, came with a tumour of the right femur with a pathological fracture. Aspiration biopsy was negative. The patient was treated for the supracondylar fracture of the femur. He was treated by skeletal traction using a Bohler's pin through the upper end of the Tibia and was treated by deep x-rays. On re-xray the tumour appeared calcified and the fracture showed healing. After a period of 9 months, x-ray showed that the fracture had united. This case was shown as an example of osteoclastoma causing pathological fracture even though aspiration biopsy was negative. (Fig. 47.)

### ASSESSING THE ONSET OF MALIGNANCY

It is well known that these tumours in a certain proportion of cases undergo malignant transformation. It is very difficult to say whether at any time a particular case under treatment has undergone malignant

change or not. It is stated by the Radiologists that the clear cut curved line of demarcation in the shaft when it becomes ill defined, can be considered to be a sign of malignancy along with proliferative reaction of the periosteum.

#### ROLE OF DEEP X-RAYS

The surgical procedure of excision and bone graft was done in most cases when growth was considered fit for excision in the earlier stages. It was the experience that the tumour which had softened in areas spilt during dissection and a lot of care had to be exercised while dissecting out this tumour. One case which was considered malignant on radiological grounds was subjected to x-ray treatment and after three months was partially amputated using Chopart's technique with modification. Even though the tumour was big and the skin was stretched over it, it was found easier to dissect it, without spilling after radiation. Based on this experience, routine irradiation of the tumour before excision is suggested. The underlying idea is—

- (a) to eliminate any radio sensitive tumours thus acting as a check on the diagnosis;
- (b) it is of the nature of a therapeutic test; and
- (c) it helps the dissection of the tumour making subsequent operation technically easier.

#### THE VALUE OF ASPIRATION BIOPSY

Aspiration biopsy is an aid in establishing the diagnosis. It is very difficult for us to state whether the dangers of biopsy are real or not. So far there have been no adverse effects after doing these biopsies. The aspiration biopsy sometimes is not helpful. This may be due to faulty technique in aspiration or suction. The aspiration biopsy if successful may help in determining the onset of malignancy, but it must be remembered the converse is also possible, the aspiration or suction biopsy may be from a region of the tumour showing only benign cells even though the tumour is defi-

nately malignant (case No. 15). The use of Turkel Trephines has been a distinct advance in aspiration biopsy.

#### OUR PRESENT POSITION

The position to which we have arrived in the treatment of these osteoclastoma can be summarised thus:—

- (1) routine clinical examination.
- (2) examination of urine for albumin, Bence Jones protein etc.
- (3) examination of blood for Wasserman, blood chemistry especially blood calcium and blood phosphatase, blood picture.
- (4) plain x-ray.
- (5) aspiration, incisional or Turkel Trephine biopsy.
- (6) preliminary deep x-rays.

*The treatment adopted in the unit is as follows:—*

1. In the beginning when deep x-ray facilities were not available, radiation with interstitial implantation were tried with poor results. Cases Nos. 2 and 6.

2. Radical local excision and bone graft. Usually done as one stage operation but may have to be done in two stages. The indications for doing in two stages are either shock or sepsis (Cases Nos. 9, 12, 14 and 15) No. 15 proved a sarcoma and after excision the case is under observation before bone grafting is undertaken.

(a) In one case, the patient was shocked before the bone graft could be taken and the grafting was done later (Case No. 9).

(b) In one case there was definite sepsis, the patient having come with an ulcerated growth and when the operation was done in one stage, the graft got infected and came away partly as a sequestrum. Though the wound healed by first intention a fortnight after removal of stitches, the patient began to run a temperature with pain. Ultimately, the graft had to be removed as a sequestrum. With this experience it has been decided not to do excision and bone

grafting at one stage but defer it if there is a focus of sepsis nearby (Cases Nos. 10 and 15).

3. Sometimes mere excision is done in certain situations. Case No. 11—upper end of Fibula was excised and grafting was considered superfluous in this case. Sometimes mere excision with re-construction is the operation of choice as in Case No. 17 where there was a pathological fracture in the neck of the Femur.

4. Amputations are done in cases which are not amenable to excision. The following types of amputations were done.

(i) Chopart's amputation with modification. Case No. 1 for metatarsal growth. Case No. 8.

(ii) Removal of a finger when the growth is limited to a finger or metacarpus. There was only one case of this type but it is being treated by x-ray. Case No. 16.

(iii) In gross involvements amputation at the seats of election. (Cases Nos. 2, 3 and 7).

5. Excision with diathermy knife. Case No. 4.

6. Deep x-ray treatment only. This is under investigation. Case No. 16.

A tabular statement of 17 cases with follow up notes wherever possible is appended to this paper.

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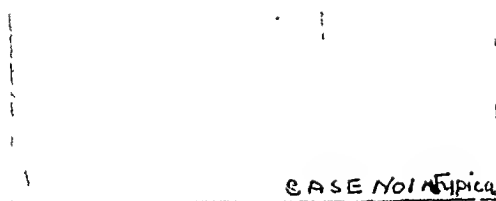


Fig. 46.

Radiogram showing the cystic condition of the diaphysis extending from the junction of middle and upper third extending down the shaft to junction of middle and lower third—note the soap bubble appearance.

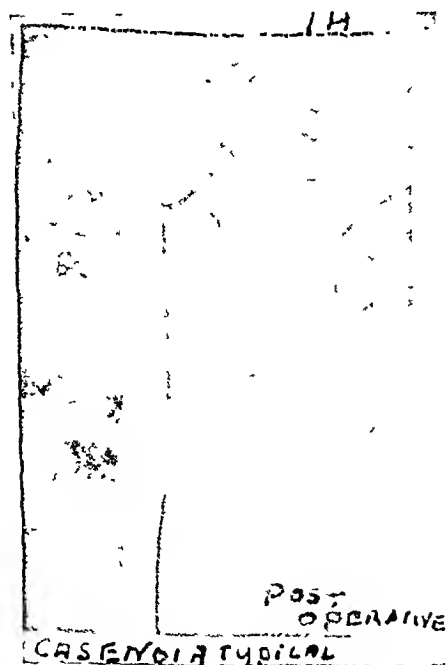


Fig. 46-a.

Radiogram showing the graft put in after excision of the growth.

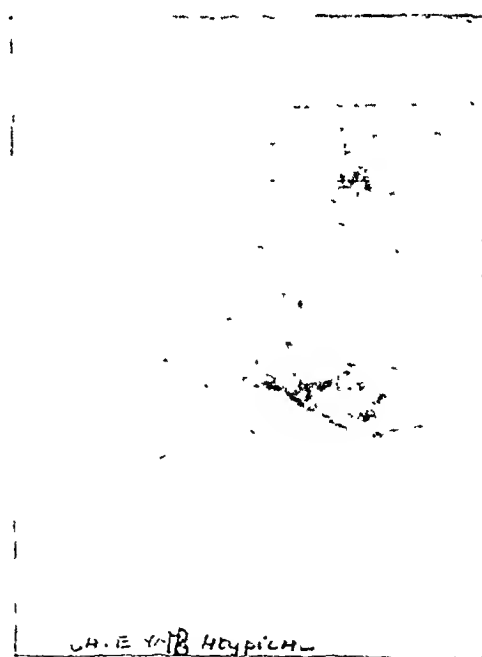


Fig. 47.

Radiogram showing the healed supra-condylar fracture of the lower end of the femur—note the soap bubble appearance.

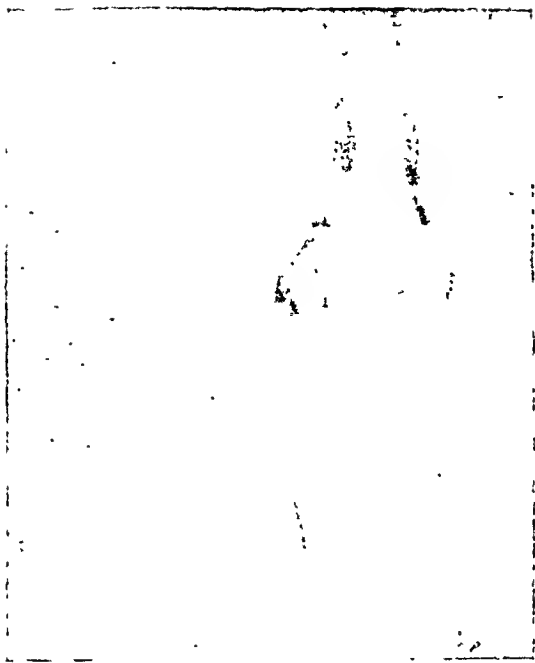


Fig 48.

Shows the lateral view but the cavitation is marked though thickening is greatly seen in the upper part of the tumour—this is a post radiation picture.

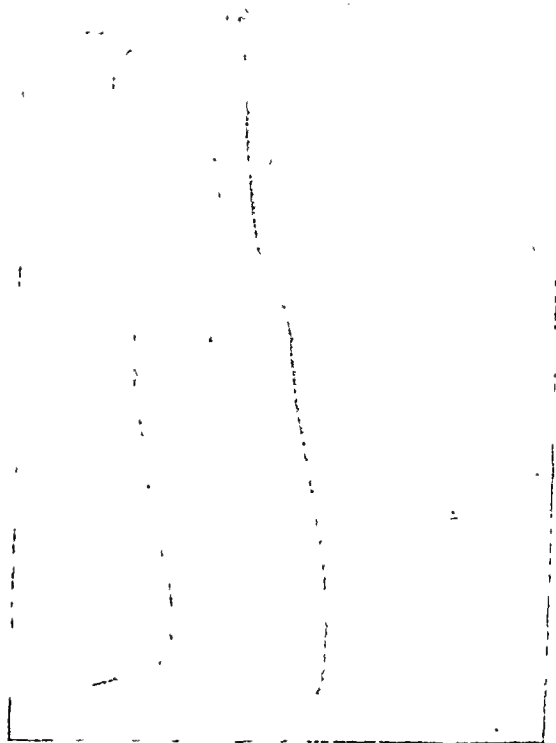


Fig. 49.

Is a clinical photograph showing the growth in the lower end of the femur.

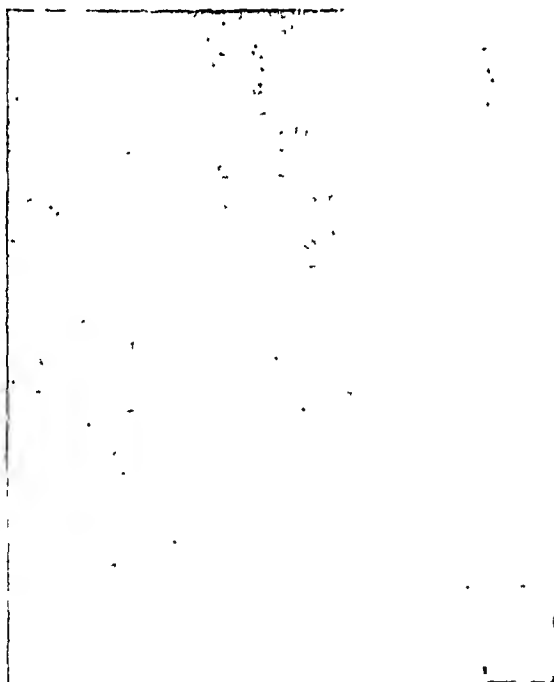


Fig. 49-a.

Radiograph picture taken of the amputated specimen—note the enormous size of the growth and the end of the bone projecting into the growth appears to be normal and uniform.

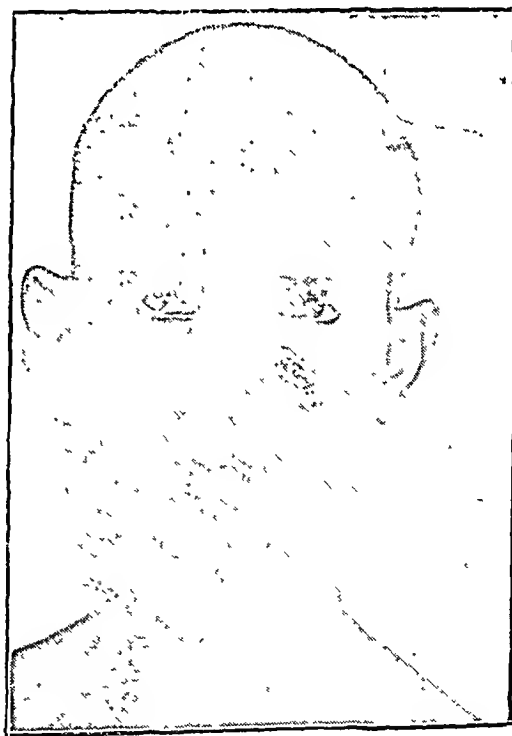


Fig. 50.

Shows the growth in the region of the maxilla on the left side.



Fig 50-a

Shows expansion of the growth after waiting for some days in the hospital

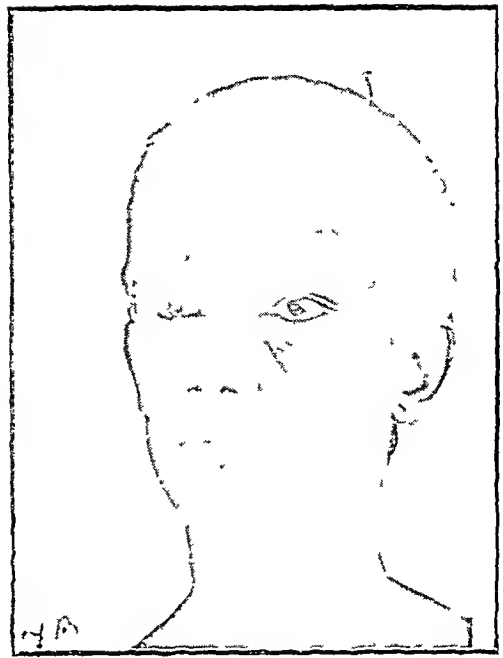


Fig 50-b

Is a clinical photograph taken after diathermy excision of the growth—note regression of the growth.

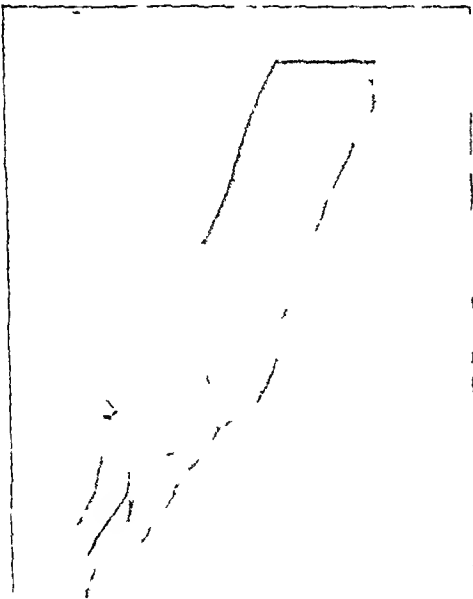


Fig 51

Is a clinical photograph showing the growth in the lower end of the radius

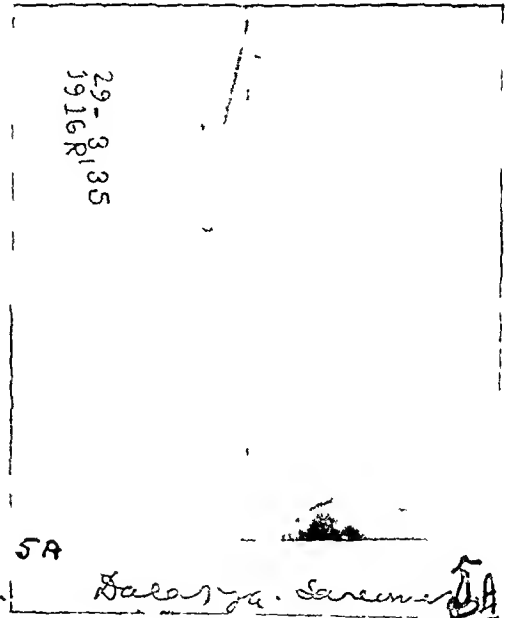


Fig 51-a

Radiogram showing the typical appearance of the growth—it was suspected to be malignant case from the size of the growth

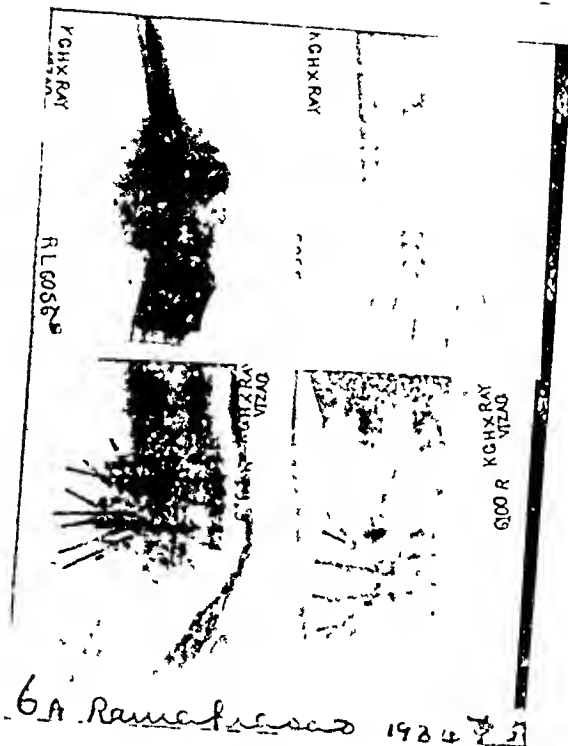


Fig. 52.

Two radiograms—show the size of the growth in the lower end of the radius.

Fig. 52-a.

Two radiograms show the radium needles in situ—appearance suggestive of osteo-clastoma.

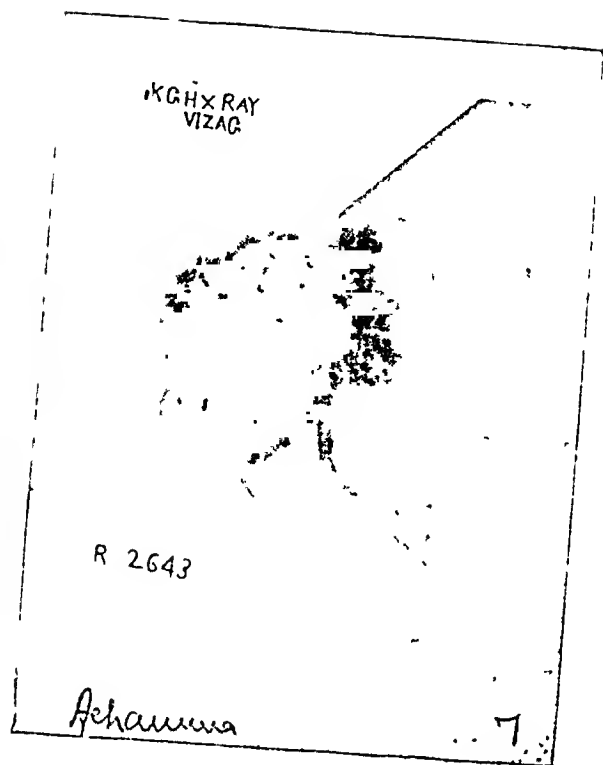


Fig. 53.

Shows the enormous growth dense in character showing the end of the bone overlapped by the tumour.



Fig. 53-a.

Clinical photograph of the growth—note the size of the growth.

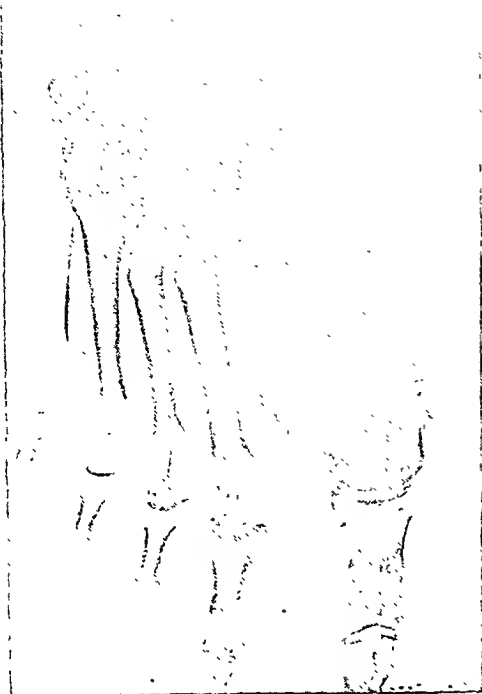


Fig. 54.

Radiogram showing the first metatarsal is entirely replaced by tumour tissue—head of the first metatarsal is appreciable but the rest of the bone is not appreciable.



Fig. 55.

Radiogram showing growth in the upper end of the humerus—note the size of expansion and also the rarefaction occurring in the shaft of the bone adjacent to the tumour. This proved to be benign histologically and at follow up.



Fig. 54-a.

Is a clinical photograph showing the result of modified Chopart's amputation.

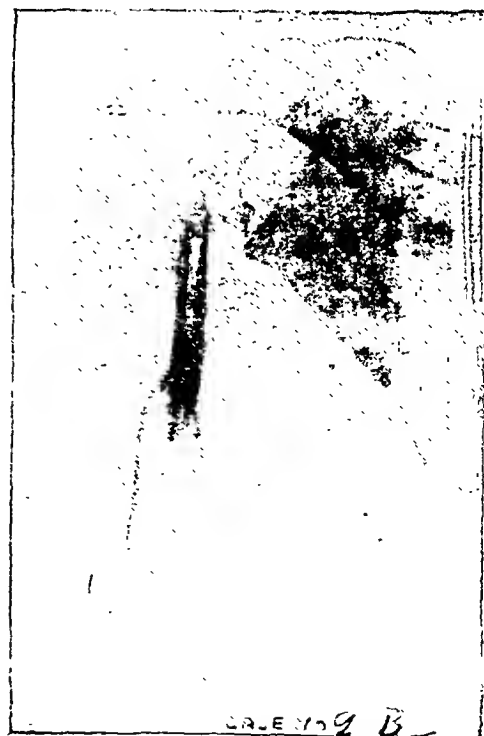


Fig. 55-a.

Radiogram showing the result after 1 year—note absorption of the graft in its proximal part.



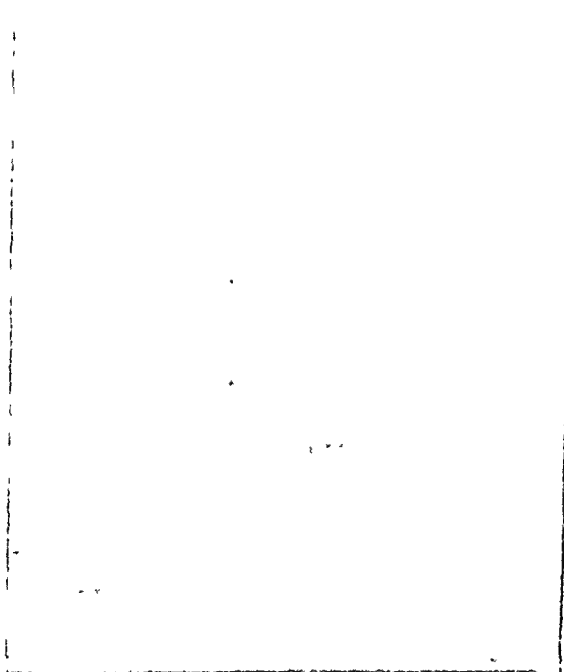


Fig. 56.

Shows the typical appearance of osteoclastoma in the lower end of the tibia—A.P. view.

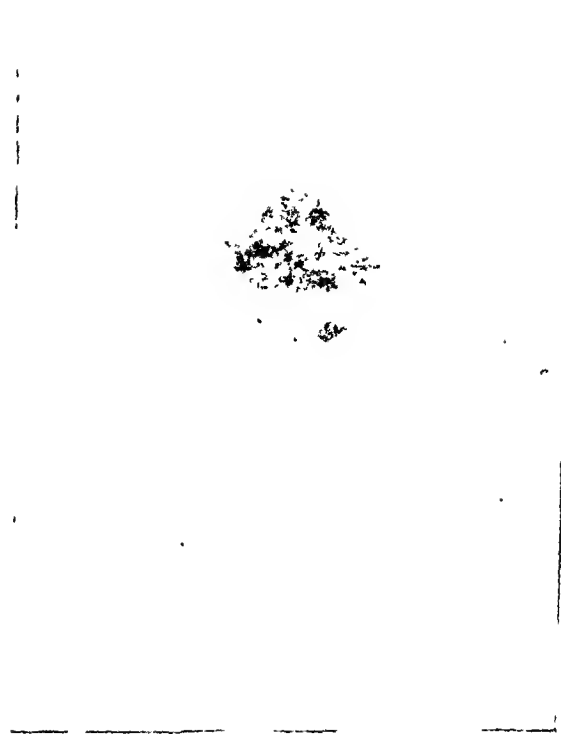


Fig. 56-a,  
Lateral view.

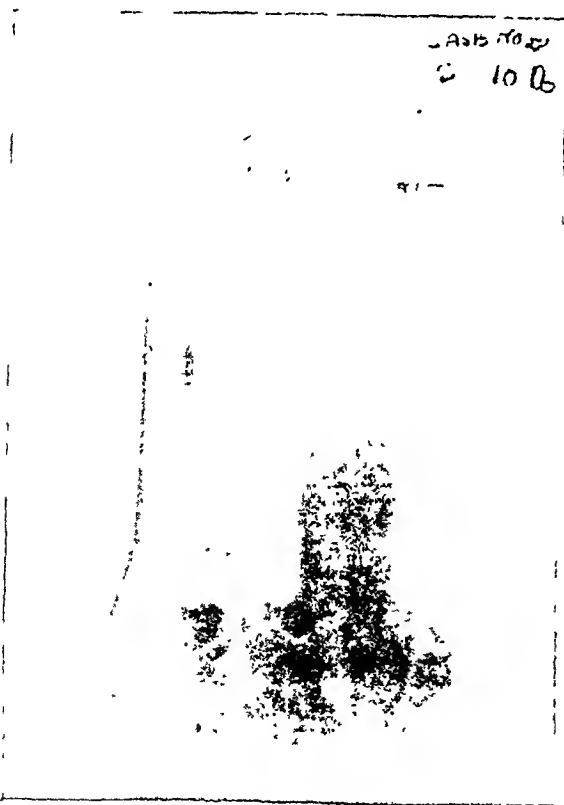


Fig. 56-b.

Radiogram showing after excision of the growth and bone graft—note the density of the graft below and separation from the proximal part of the graft showing the graft has sequestered.

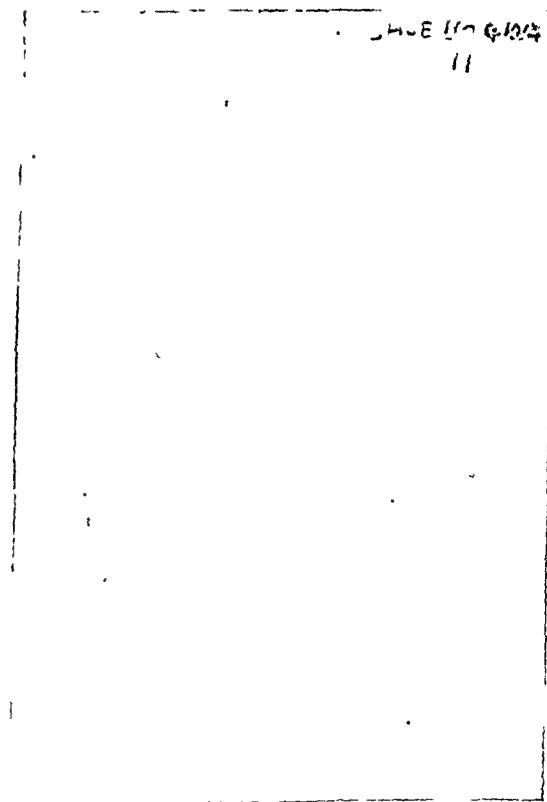


Fig. 57.

Radiogram showing typical appearance of osteoclastoma of the upper end of fibula.

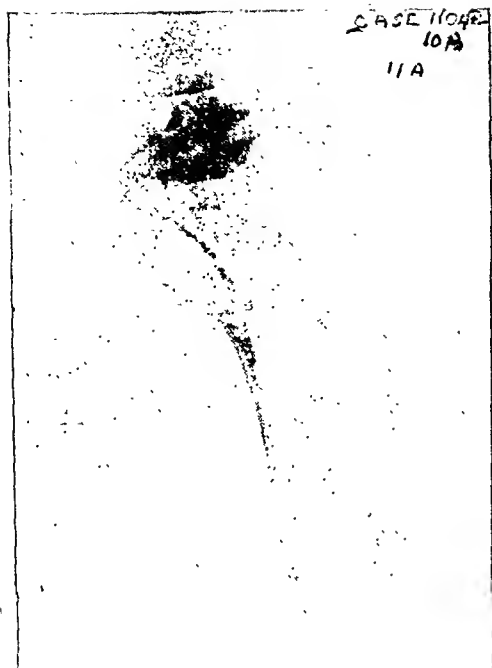


Fig. 57-a.  
Radiogram showing after excision of the same.



Fig. 58-a.  
Radiogram after excision of the growth and bone graft—note bone graft has taken well.

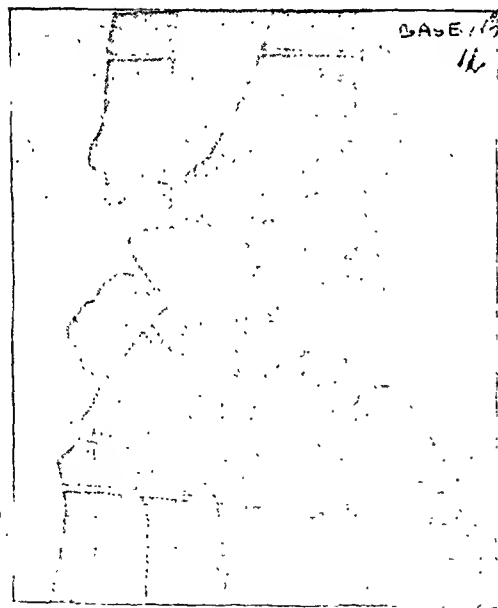


Fig. 58.  
Radiogram showing osteo-clastoma in the lower end of the radius.



Fig. 59.  
Radiogram showing the osteo-clastoma in the lower end of the ulna.



Fig. 59-a.

Radiogram after excision of the growth and bone graft.

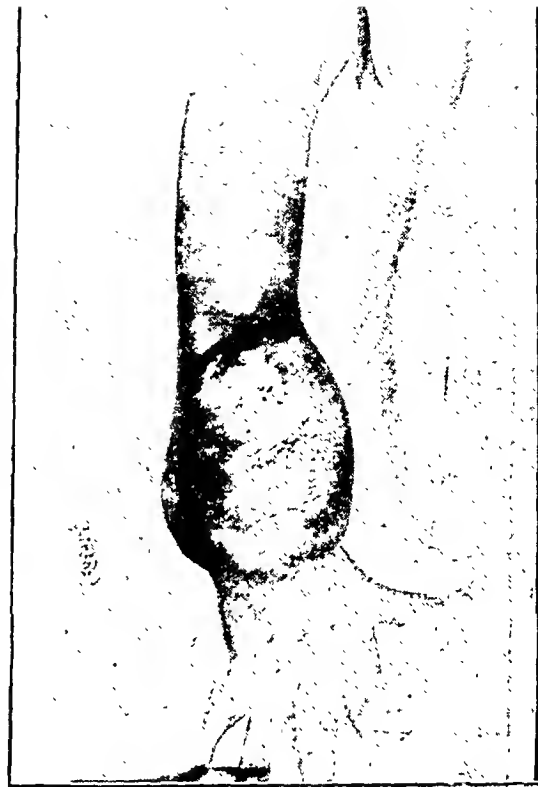


Fig. 60-a.

Clinical photograph—A.P. view of the growth.

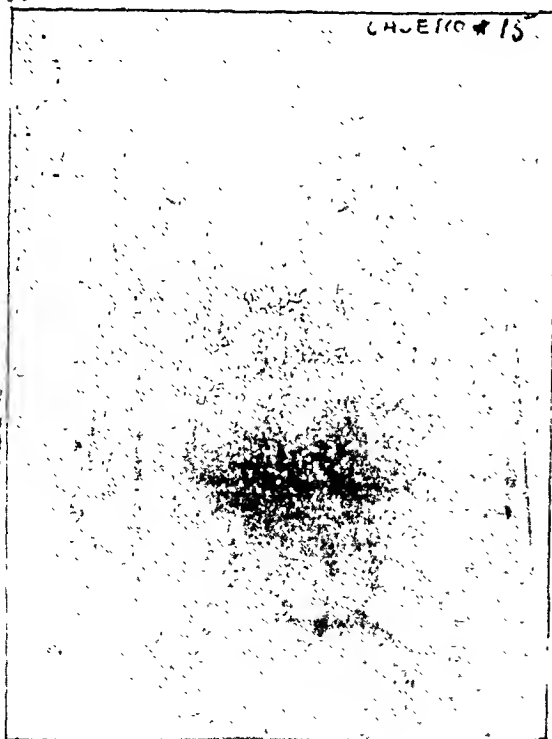


Fig. 60.

Radiogram showing big sized osteo-clastoma lower end of the radius.



Fig. 60-b.

Clinical photograph—lateral view.

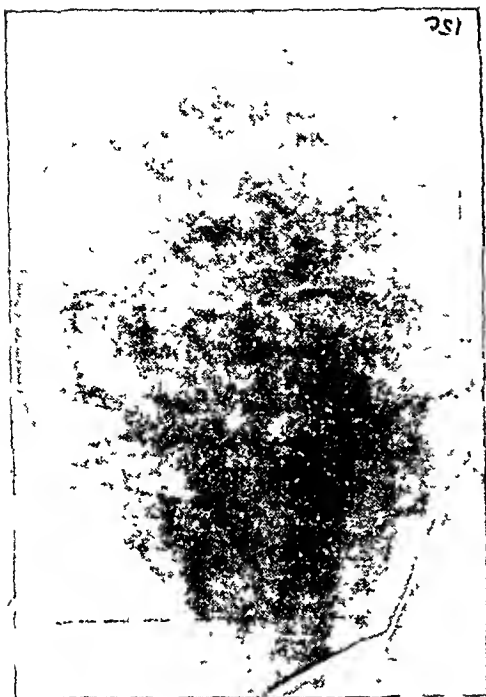


Fig 60-c.  
Radiogram taken after radiation.



Fig. 61.

Growth seen in the 4th metacarpal of the hand—note the 4th metacarpal is entirely replaced by the growth except at the distal end of the bone.



Fig. 60-d.  
Radiogram taken after excision.

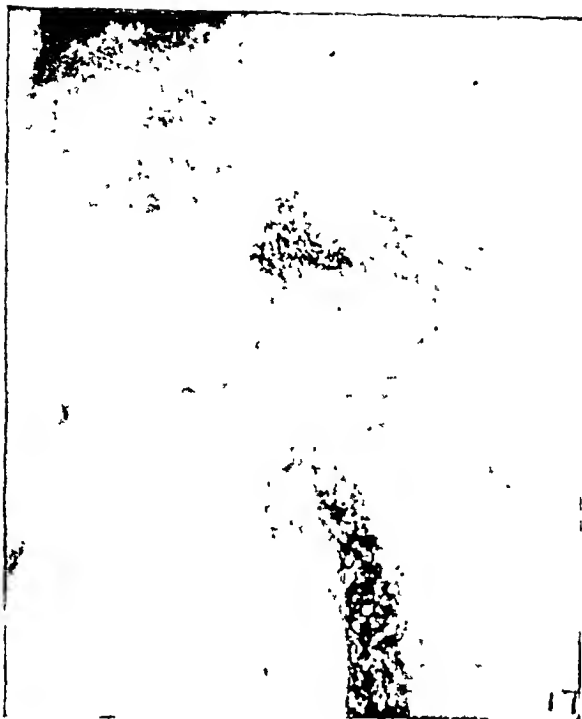


Fig. 62.

Is a radiogram showing the pathological fracture. Note the cystic evidence in the neck of Femur.



Fig. 62-a.

Is a radiogram after reconstruction of hip.

# OSTEOCLASTOMA

Serial No.	Name	Age & Sex	Duration	History	Bone and site and x-ray findings	Pathology report and investigations	Treatment	Result
1	Gopalakrishna	36 yrs. H. M.	1 year	History of accident, twisting of his knee	Upper end of left tibia-x-ray appearance suggestive	Biopsy not done	Advised local excision and bone graft	Discharged otherwise.
2	K. Rahaman Fig. 48	27 yrs. H. M.	3½ years	History of accident, was operated in Rangoon, gouging and scraping	Lower end of left femur. Typical x-ray appearance	Biopsy not done, Rangoon diagnosis—Osteoclastoma	Radiation done to return at 1 year's interval	Discharged otherwise as the tumour did not show any regression though there was calcification. Advised amputation, later heard he was amputated elsewhere.
3	Radha Fig. 49, & 49a	30 yrs. H. F.	1 year	While carrying a load she fell and sustained an injury to the lower and left thigh	Lower end of left femur x-ray was taken after amputation	Biopsy not done, after amputation Osteoclastoma	Amputation seat of election	Patient reported three years after operation that she was well.
4	Subba Rao Fig. 50, 50a & 50b	30 yrs. H. M.	3 years	No history of accident	Left upper jaw; x-ray not definite	Biopsy not done, after excision Osteoclastoma	Complete diathermy excision	Patient reported 2 years after operation with no recurrence.
5	Dalayya Fig. 51, 51a	40 yrs. H. M.	2 years	History of trauma, 3 years before	Lower end of right radius; shows marked expansion of bone with faint trabeculation	Biopsy not done	Advised amputation but refused	Discharged otherwise; follow up not possible; letter returned from D. L. O.
6	Ramaprasad Fig. 52, 52a	45 yrs. H. M.	6 months	History of fall	Lower end of right radius; shows marked expansion of bone with trabeculation	Biopsy not done	Interstitial radiation 9822 mgm. hours	Not favourable reaction; follow up not possible. Letter returned from D. L. O.
7	Achamma Fig. 53, 53a	35 yrs. H. F.	1 year	History of injury	Lower end of femur; shows very marked expansion with fine trabeculation	Biopsy not done, after amputation Osteoclastoma	Amputation seat of election	Letter returned from D. L. O.
8	Puttanayya Fig. 54, 54a	22 yrs. H. M.	1½ months	No history of injury	Metatarsal; The whole of metatarsus replaced by tumour except the distal end where fine trabeculation is seen	Biopsy not done, after excision Osteoclastoma	Modified Chondroplasty	Good result. Three years after operation wrote that he was all right and the stump was functioning well.

# OSTEOCLASTOMA (Contd.)

Serial No.	Name	Age & Sex	Duration	History	Bone and site and x-ray findings	Pathology report and investigations	Treatment	Result
9	Meenakshi Fig. 55, 55a	22 yrs. H. F.	1½ months	Definite history of fall on left shoulder	Upper end of humerus; the whole of upper end replaced by tumour faint trabeculation	Biopsy not done, after excision Osteoclastoma	Excision, bone graft in 2 stages, graft was from fibula	Graft got absorbed partially especially in the proximal portion; Reported for follow up in November 1943; shoulder movements poor; advised 2nd operation of arthrodesis with bone graft but refused.
10	Somanna Fig. 56, 56a & 56b	40 yrs. H. M.	6 months	Definite history of local injury, knocked against a stump of wood	Lower end of tibia; typical radiological appearance	Biopsy not done, after excision Osteoclastoma	Excision with Talus, a sliding type of bone graft done & impacted into Os calcis to restore continuity.	Pt had come late with sinus, graft got infected though initially healing by first intention occurred. Part of graft came away as sequestrum; part of it took. He left hospital walking with a slight limp after a 2 years stay in hospital. No follow up available.
11	Jeddy Fig. 57, 57a	37 yrs. H. M.	1 year	History of injury	Upper end of fibula; typical radiological appearance	Biopsy not done, after excision Osteoclastoma	Excision	Good result; Follow up no reply to p.c. written on 22-7-1947.
12	Manickamma Fig. 58, 58a	40 yrs. H. F.	6 months	Definite history of injury	Lower end of radius; typical radiological appearance taken 4 months before admission, expanded further at time of operation	Biopsy not done, after excision Osteoclastoma	Excision and bone graft from tibia	Very good result; fairly good functional result; Reported last on 6-10-45; Reported to p. c. sent on 22-7-47. No recurrence, no pain, able to do most household work.
13	Devasirvatham	42 yrs. H. M.	1 year	Fall from cycle on his back, early suspected fracture	Last two pieces of sacrum is thinned out and markedly concave	Biopsy not done, after excision Osteoclastoma	Attempted excision	Shock due to haemorrhage after operation — death. There was no blood bank to relieve the shock.
14	Perumalswami Fig. 59, 59a	37 yrs. H. M.	1½ year	No history of injury	Lower end of ulna; typical radiological appearance of an x-ray taken 1 year before — Bone had expanded considerably at time of operation	Biopsy not done, after excision Osteoclastoma	Excision and bone graft from tibia	Very good result; excellent function Patient reported for follow up on 29-7-47.

15	Ganapathy Fig. 60, 60a, 60b, 60c & 60d	36 yrs. H. M.	1 year	No history of injury	Lower end of radius; typical appearance	Biopsy done Osteoclastoma; after excision Sarcoma	Under treatment having deep x-rays prior to Surgery; had three blood transfusion	Readmitted Jan 1948; General condition good; Good calcification of tumour; Wide excision of radius done using ulna as a temporary graft. Pathological report—sarcoma.
16	Kathavarayan Fig. 61	18 yrs. H. M.	1 month	Lifted heavy weight, attributes his trouble definitely to accident	IV Metatarsal left; marked expansion of 4th metacarpal very faint trabeculation	Biopsy Osteoclastoma	Treated by deep x-ray therapy	Under investigation and observation; watching the result of radiation.
17	Mr. Anandathirtha Rao admitted on 31-1-46 Fig. 62 62a	42 yrs. H. M.	Pain one year Fracture 10 days	No definite history of accident Serum protein 6.85 mgs% Calcium mgs% 5 Inorganic phosphate 5 mgs%	Pathological fracture due to Osteoclastoma? There was no other evidence of similar condition in other long bones.	After excision Osteoclastoma	Excision; Whittman's Reconstruction	Good result at the time of discharge.



## DISCUSSION

Dr. R. Mahaderan: 1. As is known only too well, patients usually come to hospitals in very advanced stages of these conditions. Figs. 1-4 show clinical photographs and reprints of skiagrams of a patient with an osteogenic sarcoma of the maxilla. A glance at the figures will show that treatment in any form is out of the question.

2. The American Registry of bone sarcomas is an authoritative publication. According to the findings therein osteogenic sarcomas are usually very painful and the progress of the disease is such that it is unusual for the patient to resort to treatment earlier than a month or later than a year. (b) They do not occur in the aged, unless

into the cavity. This method is said to favour early healing and lessens the period of convalescence. (Ycar Book of Surgery, 1944).

4. *Traumatic cyst of skull.* The clinical photographs (Figs. 5 to 7) show a case of what may be described as a "traumatic cyst of skull." The patient at the age of 10 sustained severe injuries in a railway accident, resulting in crushed right foot, injuries to face, forehead, etc. 15 years later (in 1935), she reported to hospital with a large swelling in the forehead (Fig. 5), which was first noticed at the root of the nose 7 months previously. It was bony hard in the lower part while the upper part was thinned out and yielding. She had also condylomata of the vulva, which healed with antisyphilitic treatment. The forehead swell-

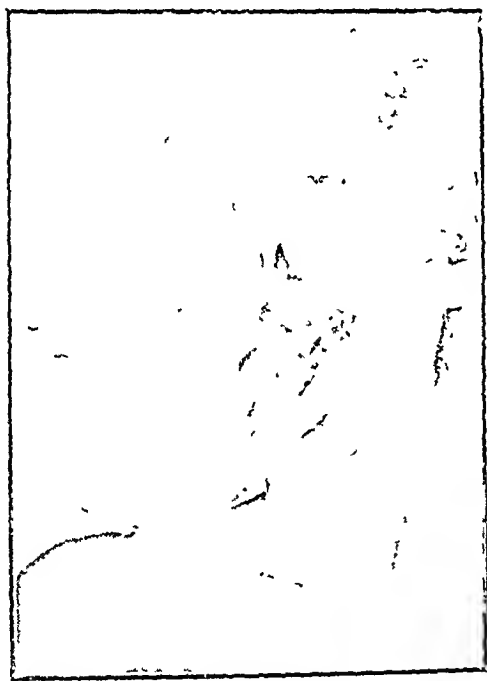


Fig. 1.

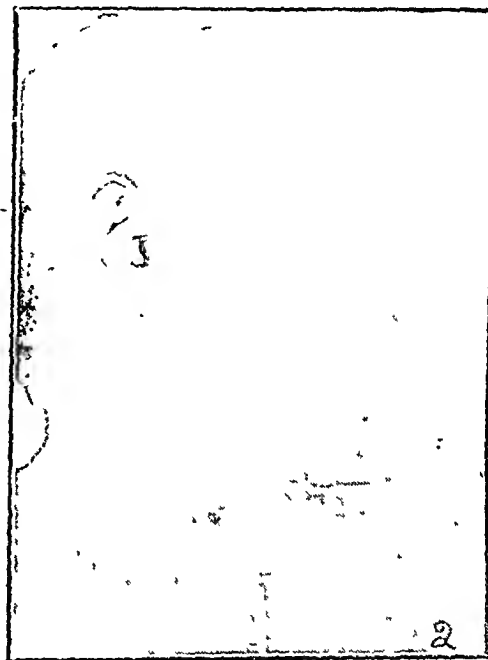


Fig. 2.

A.P. and lateral views of an advanced case of Tumour Maxilla.

as a complication of an already existing pathological condition as for eg. Paget's disease of bone. One hesitates to contradict the findings of such an authoritative pronouncement but some of the cases occurring here do seem to exhibit some differences. Thus, some patients come complaining of the swelling which has attracted their attention and not the pain as a prominent feature. Cases of osteogenic sarcoma have occurred occasionally in the elderly in the absence of any other pathological condition.

3. In cases of benign giant cell tumours, healing of the cavities resulting after curettage, may be hastened by skin-graft. A mould of the cavity is prepared with Stent's wax, skin-graft with the mucous surface out is laid on it, and introduced

ling, though it did not disappear completely, was stationary for about 6 years. Then it began to gradually increase in size and in 3 years reached the condition shown in Fig. 6, and during the last three months was growing rapidly, with local pain as well as headache. It interfered with vision considerably due to its overhanging the eye. The swelling was smooth and globular, had hard bony margins, and there was egg shell crackling in places. Overlying skin was healthy. Regional lymph nodes were not enlarged. The fundi were normal. W.R. was positive strong, but antisyphilitic treatment had no effect on the swelling. 60 c.c. of thick dirty brown material was aspirated through one of the soft spots which showed in the microscope only amorphous material.

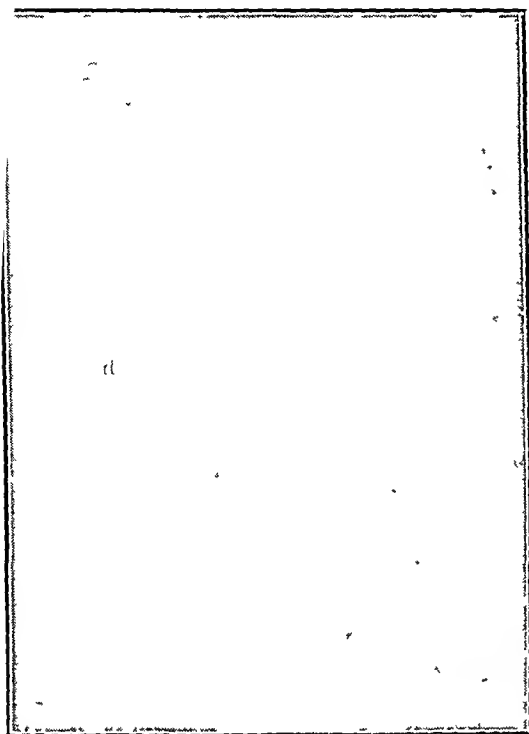


Fig. 3.

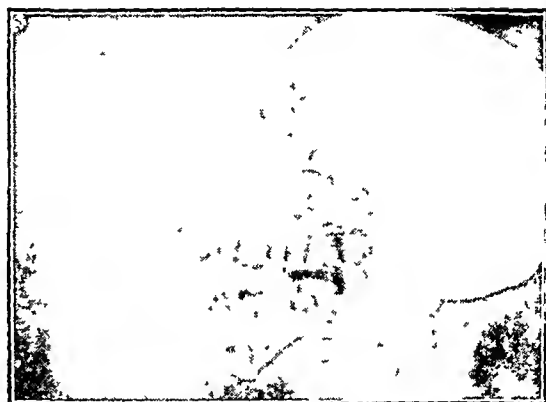


Fig. 4.

A.P. and lateral skiagrams of the same patient.



Fig. 5.

"Traumatic cyst of skull" (Frontal bone)  
Condition on 19-6-35.

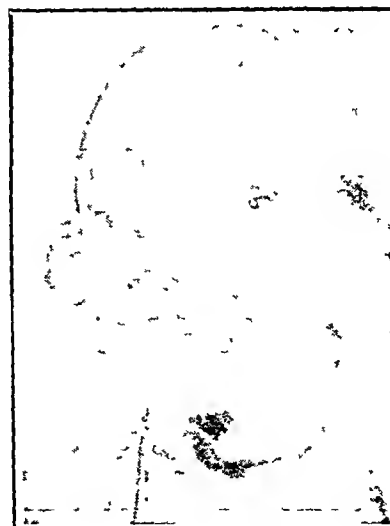


Fig. 6.

Same case as Fig. 5 Condition on 24-4-44.  
(Before operation).

On 8-7-44 the swelling was operated on and the bony wall was removed. The contents were a fair amount of thick dirty brown gelatinous fluid. The posterior wall was very thin in places and as it was feared that this may be the only partition



Fig. 7.

Same case as Figs. 5 & 6. Condition on 27-7-44. (After operation).

between the tumour and the meninges, this was not removed, but the lining of the cyst was carbonised and washed with spirit. The post-operative course was uneventful except for the necessity for three or four aspirations of collected fluid. Fig. 7 shows condition after operation.

Pathological examination of cyst wall showed a lining of granulation tissue with pseudo-xanthomatous appearance: no evidence of dermoid.

Her general condition improved and vision became perfectly normal.

The above condition fits in best with what the Americans call "traumatic cyst of skull." (Ref.: Surg. Gynaec & Obst.)\*

Dr. U. Mohan Rau: demonstrated skiagrams of a case of secondary deposits from a carcinoma of the breast. The secondary deposit in the humerus was of the osteolytic variety and the secondary deposit in the skull was of the osteoblastic variety, thereby demonstrating that the same tumour can produce both osteolytic and osteoblastic bony metastasis.

He also showed the X-Rays of a patient with carcinoma of the prostate who had secondary deposits (osteosclerotic) in practically every bone in the body but his lungs were free from sec-

dary deposits, thereby proving Batson's theory of distant metastasis in prostatic carcinoma through the inter-communication between the pelvic plexus of veins on the one hand and the spinal and the other systemic veins on the other hand.

Dr. N. S. Narasimhan: The figures just given out from Tata Memorial Clinic show a very large preponderance of Ewing's tumour. Even allowing for faults in diagnosis, the figure seems high and requires explanation. My own personal series shows 53 bone sarcomas in ten years. Only 4 of these are Ewing's. There were 60 bone biopsies in the Pathology Department of the Madras Medical College in ten years and there were 6 cases of Ewing's tumour. It is accepted that amputation in Osteogenic Sarcomas and Xradiation in Ewings form the standard treatment at present. There is no difference of opinion regarding the ultimate prognosis of these cases. The difference of opinion lies in the early diagnosis and its difficulties. Since the recent War years, one meets with many cases of Pyogenic osteomyelitis of low grade toxicity with good deal of bone pain and biopsy has been essential in correctly diagnosing these cases. In one instance where the radiologist was of opinion that the case was one of sarcoma and too far advanced for radiation, the case happened to be one of Osteomyelitis. Biopsy is essential for jaw tumours since cases of plasmocytoma will be otherwise misdiagnosed and unnecessary operation be undertaken. It happened in one instance in this series. During this ten year period I had 32 cases of giant celled tumour of bone. There were different kinds of treatment during this period. Simple curettage, curettage with swabbing with chemicals as carbolic acid or zinc chloride, excision of bone such as the talus and the lower end of the radius, excision followed by bone graft as in the lower end of the tibia, excision followed by the use of half of the femur (Putti's Operation) were being done. For the past three years, deep X-ray therapy was given after any of the procedures to avoid recurrence. It was soon noticed that in 3 cases, the tumour became malignant clinically and histologically, and led to amputations. Just at this period Brailsford published in the Medical Annual similar experiences and advised that the treatment should be either only radiation or only surgical procedures. After a combined meeting of Radiologists and Surgeons, we in Madras have agreed to adopt this procedure.

Deep X-ray radiation does calcify the tumour in its periphery and this can be seen 3 to 6 months after radiation, but the tumour cells in the centre probably escape and after calcification, surgical excision with grafting is required. There were many mistakes in the diagnosis in the early stages of giant celled tumour; the area of loss of density has been mistaken for tuberculosis: one of the cases of giant cell tumour of the lower end of the

#### REFERENCE\*

"The 1944 Year Book of General Surgery"  
(Graham, Evarts, A.), pages 223-224.

femur which I mistook for tuberculosis was subsequently admitted into another hospital for Pathological fractures. Giant celled-tumour of Talus was mistaken for tubercle. In a series of 63 cases of bone biopsy where giant-celled tumour was diagnosed histologically, there were 23 clinical mistakes. Fullest co-operation of the Pathologist is given and obtained and Ellis' bone biopsy technique is followed. With excised bones even, one part of the tumour showed fibroma and when several sections were taken, it was proved to be telangiectatic Sarcoma.

I have found it extremely difficult to study and understand the reaction of bone to trauma and the histological changes that follow even normal calcification<sup>12</sup> after fractures. A series of normal studies are urgently required so that the students and teachers become familiar with normal microscopic pictures of repair in bone and at what stage that repair process becomes pathological.

Dr. R. N. Dixit. (1) It is sometimes impossible to diagnose a case of bone tumour, merely by clinical and radiological examination. A biopsy in each and every case of suspected bone-tumour is absolutely necessary. Every case of suspected

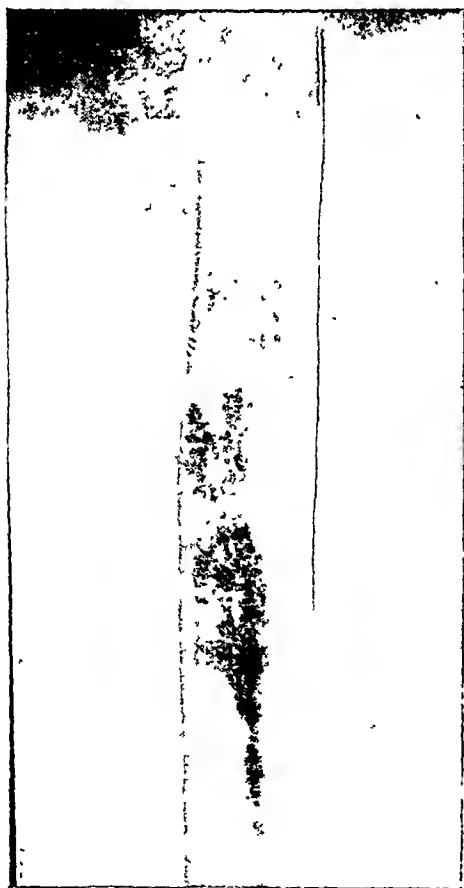


Fig. 1

—Dixit

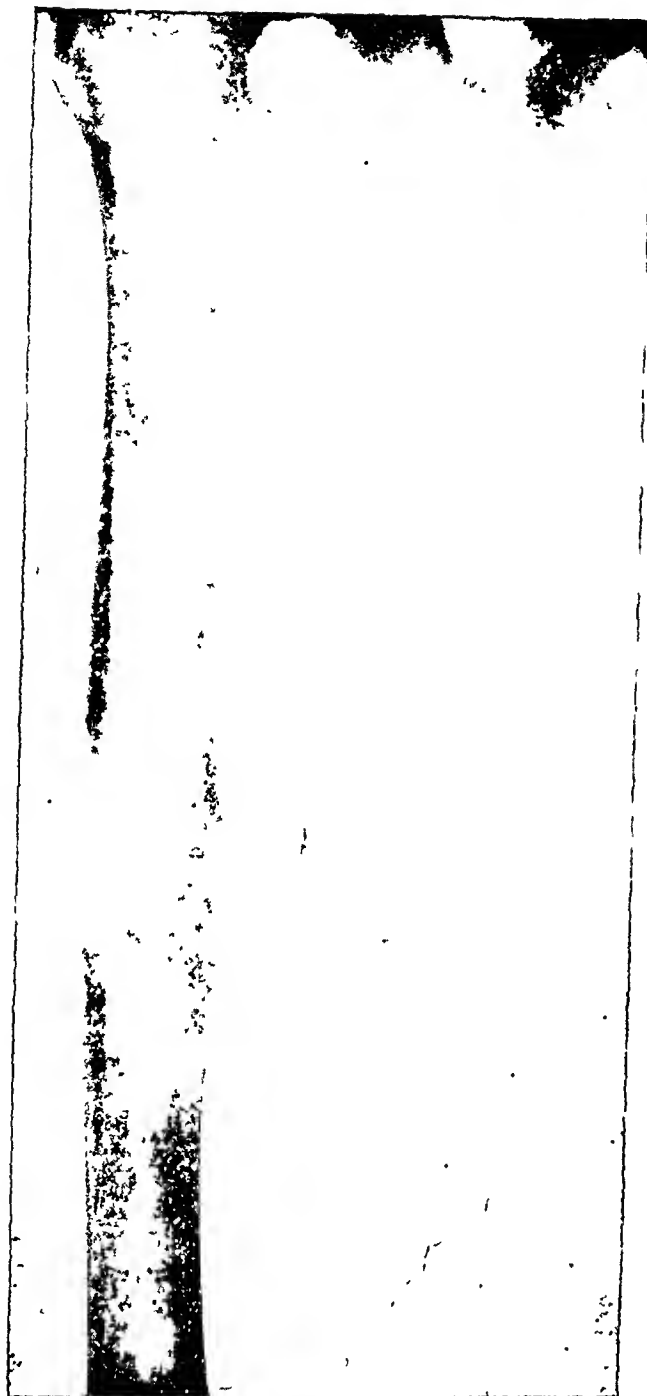


Fig. 3.

—Dixit

bone tumour should be jointly investigated and treated by the surgeon and the radiologist under the guidance of the pathologist. Removal of a piece of tumour for biopsy does not increase the risk of dissemination as is usually feared.

(2) The case report and skiagrams of a case of bone tumour were presented. A young woman

aged 25 years developed pain and swelling of the middle of shaft of femur, following some trivial injury some six weeks ago. From the clinical and radiological appearances one was led to believe it to be an inflammatory lesion. On the operation table however it was proved to be a case of bone-tumour of great vascularity. The biopsy report was not received but the speaker thought it to be a case of Ewing's tumour, which was not as rare as it was thought to be.

Dr. E. J. Borges said that he would like to emphasise some of the statements made by Dr. Meher-Homji. He drew attention to the high incidence of Ewing's tumour in the Tata Memorial Series. One might seek to explain this incidence which is higher than recorded by others by pointing out that bone tumours requiring radiation are more likely to be referred to that hospital than tumours like osteogenic sarcomas which are treated surgically at general hospitals. This, however, cannot be the case as many of the tumours sent as osteogenic sarcomas turned out to be Ewing's tumours. It must be made clear that the diagnosis of Ewing's tumour was made in all the cases by aspiration biopsy (or knife biopsy when necessary) and confirmed by the response to radiation and subsequent history of the patient.

He also wanted to draw special attention to the great importance of a definite histological diagnosis before any treatment was instituted. To illustrate this he presented skiagrams of 3 patients.

The first was of a girl of 9 years who had a lesion of the radius which had all the radiographic features described as being characteristic of Ewing's tumour. She was seen by a competent surgeon elsewhere who diagnosed it as Ewing's tumour. Seen at the Tata Memorial Hospital a clinical diagnosis of Ewing's tumour was made. As a routine an aspiration biopsy was done and a drop of what looked like purulent material was obtained. A microscopical examination revealed inflammatory exudate. She was placed on Penicillin therapy and in 6 weeks the bony tumour had subsided completely. Here was a subacute osteomyelitis which would have passed as Ewing's tumour but for a microscopic examination.

The second case was that of a young man of 20 with a tumour of the upper end of the tibia. The radiographic features were typical of osteogenic sarcoma with the characteristic sun-ray appearance. Aspiration biopsy revealed inflammatory exudate. A knife biopsy was done and confirmed an inflammatory lesion. Penicillin produced an appreciable diminution of the tumour; later the patient was lost sight of.

The third case was that of a young man with a giant cell tumour of the upper end of the tibia. Aspiration biopsy yield no material for a definite diagnosis. A knife biopsy revealed a malignant giant cell tumour. A mid-thigh amputation was done. He developed a local recurrence in the

amputated stump. A disarticulation of the hip was done. This did not prevent the patient dying from metastasis to the lungs.

All these three cases, a few out of the many that could be demonstrated, show that it is unsound to treat a bone tumour without a definite histological diagnosis. At the Tata Memorial Hos-

pital they had learnt that though a clinical diagnosis based on clinical and radiographic features was correct in a large proportion of cases, the percentage of errors in diagnosis based solely on these features was high enough to make it imperative that no bone tumour should be treated without a previous histological diagnosis. Aspiration biopsy was a simple and harmless method of obtaining this.

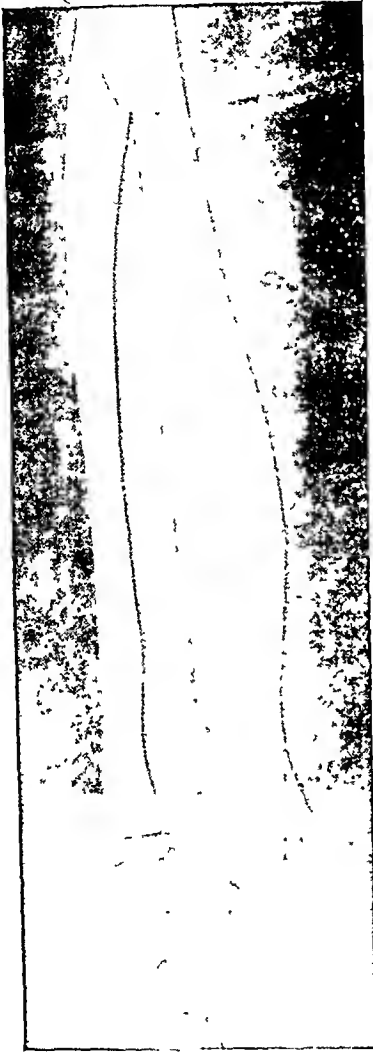


Fig. 1.

Case No. G 2056. Skiagram showing enlargement of shaft of the radius mainly from periosteal new bone formation in "onion-peel" layers, condensation of original cortex and small areas of bone destruction. Clinical diagnosis: Ewings Tumour. Aspiration biopsy: Inflammatory Tissue. Cure with penicillin. (Borges)

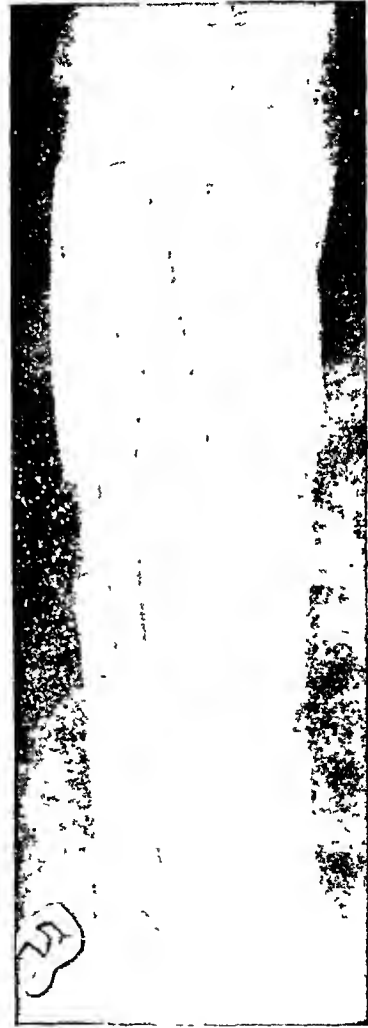


Fig. 2.

Case No. G 2056 Skiagram of same patient as in Fig. 1 taken 3 weeks after penicillin therapy. Regression of swelling, two small cavities in the centre of shaft. Subsequently patient completely cured. (Borges)

Dr. K. C. Nambiar: referred to a case of osteogenic sarcoma of the proximal phalanx of the fourth rt. toe showing the following points of interest:—

(1) History of kick from a cow on the toe one year before the complaint

(2) Unusual site for osteogenic sarcoma. At this place, a chondroma of short bones becomes malignant into a sarcoma. Here, there is no history of a chondroma.

(3) Recurrence, after a local amputation upto the middle of the metatarsal bone and a full course of deep-x-ray, in 6 months time into the inguinal glands while showing no secondaries in the chest.

(4) After complete removal of the lymphatic glands and another course of x-ray, development of subcutaneous nodules all over the body in hundreds without lung involvement.

(5) Pathological report of Osteogenic Sarcoma from (1) The toe, (2) Inguinal glands, and (3) Subcutaneous nodules.



Fig. 3.

Case No. G 2181 Skiagram showing sun-ray appearance of new bone formation described as characteristic of osteogenic sarcoma. Clinical diagnosis: osteogenic sarcoma. Aspiration biopsy: inflammatory tissue. Knife biopsy: inflammatory lesion. Improved considerably with penicillin. (Borges)



Fig. 4.

Case No. 5343. Skiagram showing a benign giant cell tumour of tibia. The slightly washed away appearance of trabeculae, and irregular broken outline at lower end of tumour, best seen in lateral view, suggests possible malignant nature. Biopsy: Malignant giant cell tumour. (Borges)

This case is of great clinical interest as the above points are variations from the normal.

Dr. Khanolkar remarked that he would particularly like to bring to the notice of the surgeons the method of aspiration biopsy of bone tumours which is employed at the Tata Memorial Hospital for two reasons.

1. The method affords a very useful diagnostic aid to the clinicians, when it is employed in co-operation with a pathologist who has been trained for this type of work. The experience of the Tata Memorial Hospital staff shows that it is probably the most reliable procedure for diagnosis in a difficult group of tumours. The advantages and drawbacks of the method, as well as the technical details have been fully discussed in a recent publication (Khanolkar, V. R., and Nerurkar, R. V.: Indian Physician, 5: 125-135: 1946) and would

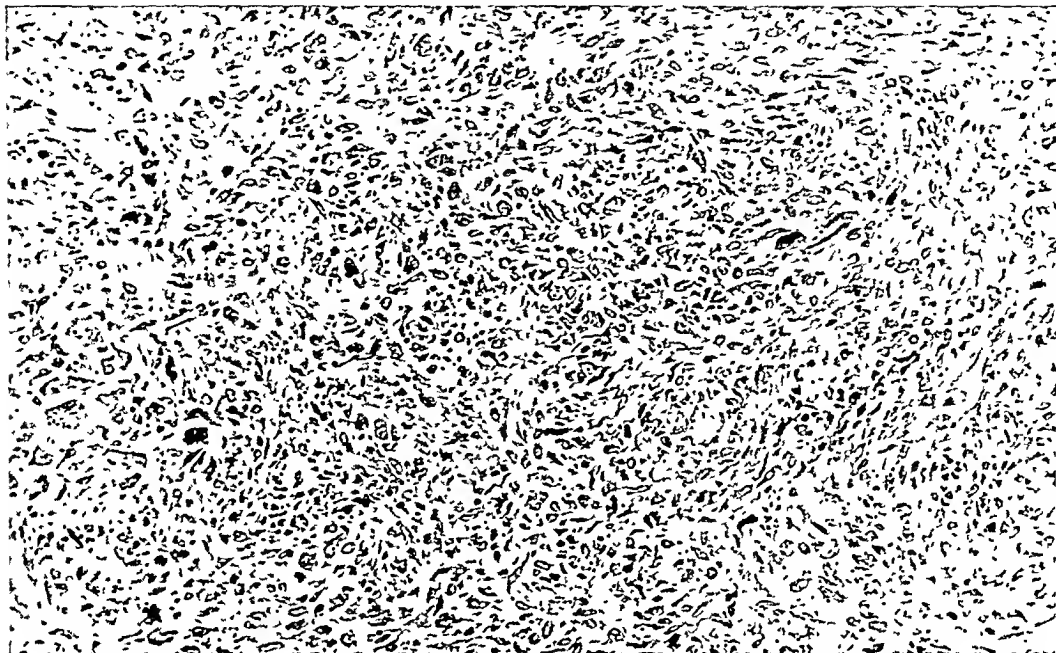


Fig. 5.

Case No. 5343. Microphotograph of tumour described in Fig. 4. It shows that the multinucleated giant cells are few, and widely separated by stroma cells which are fusiform in shape and densely packed. The nuclei of these stroma cells are mostly ovoid and show a marked variation in size: Malignant Giant Cell Tumour. (Borges)

well repay careful perusal by surgeons who may be called upon to deal with bone tumours.

2. The method does not have any of the grave consequences (ulceration, fungation, etc.) which follow an unskilful knife biopsy. The staff of the Tata Memorial Hospital avoid cutting into these tumours, unless repeated aspiration biopsies fail to establish a definite diagnosis. The experience of the past four years does not lend any support to the fear expressed at the meeting, that aspiration biopsy may precipitate a rapid spread of the tumour and considerably aggravate the course of the disease. The observations on experimental animals also do not sustain this belief (Maun, M. E., and Dunning, W. F.: Surg., Gynec. & Obst. 82: 567-572: 1946).

Dr. V. S. Sheth reported two cases—one of Ewing's tumour in a man of 40, where the Radiological diagnosis was between chronic Osteomyelitis and Ewing's tumour and where biopsy settled the issue, and a girl of 17 was suspected to have a bony tumour. Osteoclastoma in the 4th metacarpal bone, which, on biopsy proved to be tuberculosis.

Dr. K. S. Nigam: laid emphasis on the following points:—

1. Early diagnosis is a *sine qua non* in the management of bone tumours specially the malignant ones.

2. Biopsy is very helpful and if carried out with care (for example using punch or suction biopsy) was devoid of any apprehension of encouraging dissemination or metastases.

3. Radical surgery at a reasonably early stage has in the speakers' experience saved many lives.

Photographs of cases were shown.

Dr. S. J. Mehta agreed that Surgery has to be tackled with the help of the Radiologist and the pathologist if cases are to be treated successfully.

He, however, pointed out that the pathologist also is liable to make a mistake and gave an instance where in a malignant tumour in a boy of 21, biopsy did not show any malignancy.

Dr. D. G. Ojha showed the X-Ray plate of a case of Haemangio-osteoma of the orbital plate of frontal bone with the description in brief of the clinical findings. He mentioned and stressed characteristic Radiological finding of the radiating spongy pattern as that enables one to diagnose the



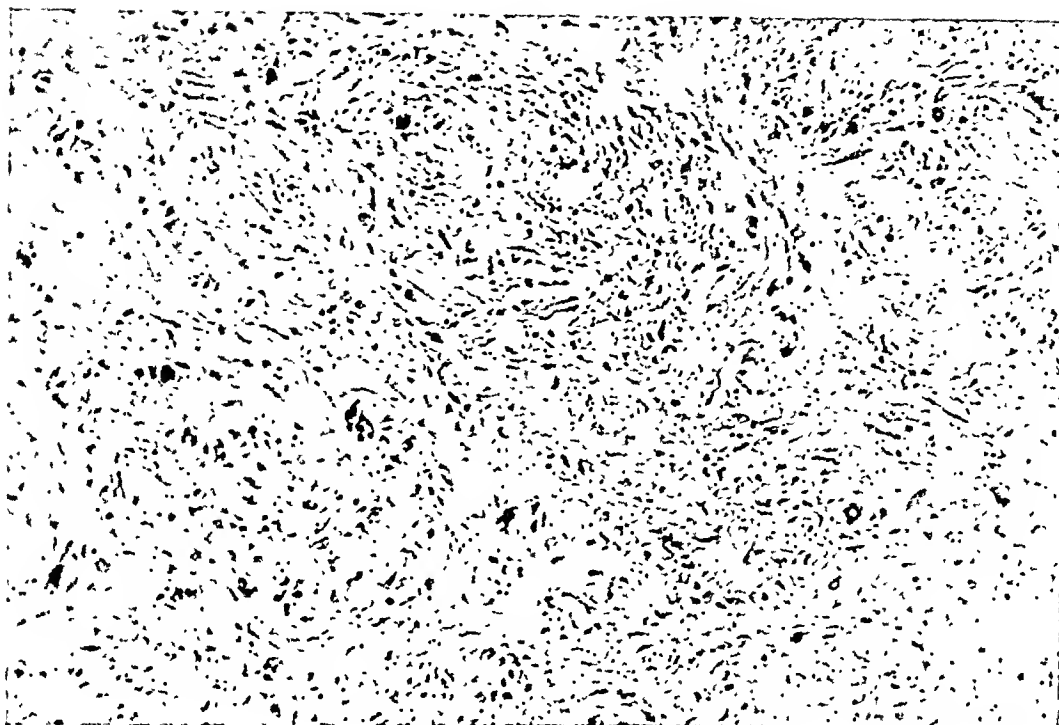


Fig. 6.

Case No. 4537. Microphotograph of Benign Giant Cell Tumour to contrast with Fig 5. It shows numerous multinucleated giant cells separated by sparse stroma cells with ovoid nuclei which are uniform in size. (Borges)

condition preoperatively. The Macroscopic appearance of the tumour is that of the cut surface of a betelnut—the white part corresponding to the bone and the brown part to the angiomatous tissue.

He mentioned that in their series of malignant bone tumours the actual case of Ewing's tumour was only one and the rest were all osteogenic sarcoma. They have had over a dozen malignant tumours during the last few years.

He stressed the possibility of wrong diagnosis of Ewing's tumour by radiological appearances alone as happened in one of their cases which on operation—opening up the medulla—turned out to be an encysted abscess in the mid-shaft of the humerus. The causative organism *Staphylococcus pyogenes* was detected, in the pus.

Further, he requested Dr. Kini to explain why he had done resection and bone grafting in a case of localized fibrocystic disease when a simple procedure like opening up the cystic spaces and curettage would have given equally good results. The condition not being a growth, but rather a developmental defect should have been treated on more conservative lines.

Dr. K. M. Rai: At the Barnard Institute of Radiology, Madras during the last seven years we

have treated 170 cases of bone tumours. Of these Osteosarcoma formed the largest number, this group contributing as much as 62.9%. Ewing's tumour formed 7.1% Plasmocytoma 2.3% Chondro Sarcoma 2.3% and Osteoclastoma 25.4%.

#### DURATION OF COMPLAINT

Among malignant tumours 46.2% reported for treatment before 3 months and 81.4% before 6 months—while among Osteoclastoma the corresponding figures were 18% and 36%.

#### AGE OF INCIDENCE

In the case of malignant tumours the maximum incidence was in the second decade viz. 33.6% and the third decade was next with 29%. In Osteoclastoma the maximum incidence was in the third decade (44.2%), the fourth decade came next (23.2%). Among malignant tumours the minimum age recorded was one and a half years and the maximum age 68 years. In Osteoclastoma no case was seen below 10 years.

#### SEX

In malignant tumours the ratio was as follows:—Males: Females:—2.7 : 1.0. In Osteoclastoma, males: females were as 3.8 : 1.0.

## SITE

In malignant tumours the frequency of incidence was more in the lower limb, this being involved in as much as 48.6%. Next came the upper limb with 19.6%. The most common site in the whole skeleton was the lower end of femur (28%) next in order was upper end of humerus (12%) upper end of tibia (10.30%) pelvis (9.3%) and scapula (7.5%).

In Osteoclastoma the most common site was lower end of femur (20.9%) next came the lower end of the radius (18.6%), lower jaw 13.7% and upper end of tibia 9.3%.

## OSTEOSARCOMA

Regarding age of incidence and site, our findings were in conformity with other workers. Regarding sex our finding is that it is more common in men while the text books put it as more common in women. We had a few cases occurring at rare sites, notable being, lower end of radius (2 cases) metacarpals (2 cases) phalanges of hand (2 cases) and tarsal bone (1 case). The treatment advised in our hospital is amputation. Where this is refused radiation therapy is resorted to. Radiation by itself has proved very disappointing. Most of our cases which we could follow up died within 18 months. Of late, being encouraged by the good results at the Memorial Hospital, New York, of the combined method of radiation and amputation, we have been following this method. We have not had the fortune to follow up all our cases; in one instance, a patient subjected to this method of combined treatment is alive still nearly three years after the onset of the disease. Osteolytic lesions responded better to X-radiation than the sclerotic types.

## EWING SARCOMA

This disease formed 7.1% of the bone tumours in our series. The maximum age incidence was in the second decade and the most common site was in the shaft of the femur. Males preponderated. Our findings are in conformity with Western authorities. Here also the outlook has been gloomy, though the immediate results are encouraging, involvement of other bones, lymph nodes and skin, all these ultimately leading to a fatal end. In our experience, the maximum survival period after commencement of treatment was 2½ years. In one case the tibial shaft was first involved; this was treated and responded well. Later the frontal bone was involved along with wide spread subcutaneous involvement of the endo-thelial tissues. When this occurred, no further treatment was recommended.

## PLASMOCYTOMA

It is in this disease that we had some gratifying results. We followed up one case as long as about 8 years, another case is alive and well, over 2 years since onset. We did not have many cases of this type, the percentage in our series being 2.3%. In the first case referred to above, the lesion originally started in the shaft of the right tibia, later it involved left patella, left femur, left eleventh rib, left humerus, skull at various sites, left maxillary antrum and ethmoid and orbit, and finally the retroperitoneal lymph nodes.

## OSTEOCLASTOMA

These formed 25.4% of our series. The maximum age incidence is third and fourth decades, whereas the Western authorities put it as second and third decades. It is in this group that we had some good results. We use only X-radiation. We do not advocate any combination of this with surgical curetting. The combined treatment which we followed in the beginning of our series gave us disastrous results with the exception of a few, in that the tumour turned malignant after some time. With X-radiation alone nearly 80% of cases have consolidated. The numbers we followed are few and we are still following this method and ere long hope to assess the permanent value of this treatment.

## Reply by Meher Homji

My job of answering the questions has been greatly facilitated, since many of the questions have been answered by my colleagues, Drs. Khanolkar and Borges. To Dr. Chatterji I may state that the regeneration and recalcification process after X-ray therapy of Benign Giant Tumour, is a very slow one, and that it takes sometimes 1½ to 2 years or even more. One must have patience with this type of treatment. Dr. S. J. Mehta asked as to why the combination of surgery and irradiation is not to be recommended. I may answer that this point has already been mentioned in my paper. Answering his other question as to why disarticulation be performed for osteogenic sarcoma of the lower end of femur, the generally accepted procedure of choice is amputation above the proximal joint of the bone affected. However in the cases of tumour involving the lower end of femur, a high thigh amputation has been recommended. Our previous experience has shown us that sometimes when a high thigh amputation is done, there is extension of disease at the site of section of bone and as it is impossible to tell radiographically how far the microscopic extension of disease has reached, it is wiser to perform a disarticulation as the life of the patient is more important than the limb.

# THE PROBLEM OF INFECTION IN BURNS

by P. K. SEN\*

I present today the report on a detailed study of a consecutive series of 160 cases of burns (thermal and from other causes) treated in the K. E. M. Hospital, Bombay, during the years 1944 to 1947. This enquiry was undertaken by the Surgical Society of the Hospital and carried out under its guidance first by Dr. G. M. Phadke and later by myself and the two whole-time research workers, Drs. Ketkar and Jahagirdar, appointed for the purpose.

In undertaking this investigation we have been guided mainly by clinical criteria; biochemical and other laboratory investigations e.g., estimation of blood protein levels, haemoglobin and cultural examinations etc., though carried out in most cases do not form the main background of this work. Since April this year, however, we have attempted a study of the nutrition of burnt patients (a series which is different from the first 160 cases) on which I wish to append notes of a preliminary report at the end of this paper.

The study of the series of 160 cases was largely concerned with the appraisal of the various factors in the production of infection in burns as well as of the methods and agents used in the prophylaxis and treatment of sepsis in the burnt patient. In order to standardise treatment all cases of burns admitted to the hospital during this period were treated by the Burns Unit and the data collected in a special summary sheet (a copy of which is presented here). Since the focus of attention was directed mainly on sepsis and factors operating in its production and control it is best to mention at the outset certain clinical methods and standards used for the purpose of this enquiry. The estimation of area was done

by Berkow's method, according to the schematic chart devised by him and approximately noted in terms of percentage of total body surface. This estimation was made on admission but was not finalised till tissue damage and early sloughing became evident, as it has been our experience that early estimation of area of burn is almost always faulty and some time (often a week or more) has to elapse before the extent of actual damage can be ascertained. The view of the other workers support this (Cope 1944 and Meleney 1945). Sepsis was graded mild, moderate or severe according to whether a purely local reaction, local reaction plus sloughing or local plus marked general reactions were present. The estimation of depth is also subject to the same fallacy as that of area and immediate estimations were not taken as final. In every case of burns there are three zones. One, which is immediately killed by heat and appears as such, one which is injured and rendered non-viable in part but does not appear to be so till some time later and a third which is not injured at all; and until there is an attempt on part of the tissues at slough formation and separation, proper estimation of exact depth is usually difficult. Quite often there is third degree burn under blisters which are stamped as superficial and are only recognised as such on the peeling away of the blistered skin and appearance of granulation tissue which may be quite late. The estimation of depth was done some time after admission with the formation of or even actual separation of slough. In accordance with modern practice depth was estimated as either superficial or deep though the presence of erythema was also noted. For the purpose of this study a superficial burn means one in which the superficial epithelium is injured to the extent of blistering and anything more severe than that short of complete destruction of the deepest epithelial elements in the skin (i.e. in the sweat and

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\*K. E. M. Hospital, Bombay. Paper read at the Annual Conference of the Association of Surgeons of India, Dec. 1947.

sebaceous follicles) from which *residual* epithelium restoration can take place. All those areas where epithelial elements are totally destroyed and healing has to take place by the advancing epithelium from the margin or by skin grafts have been categorised as deep. It is obvious that in many cases there have been large areas of superficial burns with small islands of deep burns scattered all over and vice versa and have added to the difficulty of correct estimation of depth and area but as far as possible an attempt was made to obtain reasonably accurate figures. The final results and healing was graded into three categories, viz. (1) Epithelisation without fibrosis or contractures, (2) Epithelisation with fibrosis but little or no contractures and (3) Fibrosis with contractures.

When this study was initiated there existed a great confusion in the minds of surgeons all over the world with regard to the best form of local treatment for burns. The experience of the Massachusetts General Hospital during the treatment of the victims of the Cocoanut Grove disaster (a Boston night club) had first exposed the time honoured practice of debridement to criticism (Cope 1943). Indeed this procedure had become since the advent of the tannic acid treatment by Davidson in 1925, one of the first principles in the treatment of burnt surfaces. Experience gathered from the U. S. Navy during Pearl Harbour and afterwards and subsequent extensive clinical investigations by various workers (Meleny 1945) served to show that debridement was neither effective nor desirable. In this study no debridement or cleansing of any kind was practised, except in surfaces with very large particles of road dirt, etc., adhering to them, when a gentle saline irrigation was all that was done. Greasy or any other applications used on the area before admission to the hospital was not attempted to be removed.

Burns differ from other wounds in two important respects: (1) They are usually extensive but not deep while other wounds

are usually relatively deep and not as extensive and (2) Surgical procedures aiming at removal of dead and dying tissue with the object of removing contamination and thus reducing sepsis is neither possible nor advisable as with other wounds. It is now clear that all classes of burns no matter from whatever cause, should be regarded as contaminated and potentially infected because the contamination in a burnt area comes not only from external agents but is resident in the depths of the skin itself, in itself, in its deeper layers, i.e. the hair follicles and sweat and sebaceous glands. Secondary contamination does occur as with other wounds and may play a part in the ultimate production of sepsis but is not as important. Under the circumstances forcible scrubbing and cleaning (as during debridement under anaesthesia) will serve not only to kill more tissue, particularly that partially injured by the agent, i.e. not yet dead but which may have survived if not debrided but also to drive contaminating organisms deep into the skin. The blister fluid which has been thought to be an excellent culture medium for the bacterial growth has been shown to be inimical to many pathogenic bacteria due to action of skin lipoids (Burtenshaw 1938, Jamieson 1939). The removal of the blister usually leads to the formation of a fibrin film over the burnt area which is a much better culture medium than blister fluid rich in cholesterol and other tissue lipoids. The obvious advantages of non-debridement—such as avoidance of anaesthesia or adding to the shock by surgical handling need not be enumerated here. Probably very deep burns, i.e. involving muscles and bones with charring, if localised, are the only cases to which the principle of surgical debridement can be rightly applied, and with advantage. Such cases are rare and we have not one such in the present series.

The problem of the burnt patient can be divided into certain phases all of which are not always equally manifest or clearly demarcated from the other. They are in the main five. Shock, toxæmia and nitro-

gen imbalance, infection, slough separation and repair (Meleney). During the progress of a burns case these different phases reach peaks of importance more or less in the same order, sometimes variously and often overlapping considerably. Each phase has an important part to play in the genesis of the next or succeeding ones. The problem of infection (always a serious one) which is comparatively a later manifestation is therefore seen to be closely bound with the earlier phases and factors involved in their production. One of the objects of this paper is to correlate some of these factors with the occurrence, prevention and control of sepsis by means of clinical, biochemical or statistical and other data, as well as to correlate infection and the various factors concerned in its genesis with the later phases of burns and ultimate results, i.e. mortality and healing. The role of the various factors concerned in sepsis, healing and mortality have been considered both generally and statistically in this paper and an effort has been made to correlate both.

The factors themselves are myriad but a number immediately resolve themselves as being more important. By itself probably no single factor determines the onset or nature of sepsis and many causes contribute in varying measure as will be seen in the following graphical and statistical analysis of the more important factors in the production of sepsis in this present series of 160 cases. These are considered in order of their probable importance.

**Depth :—**According to Meleney (1945) this is the most important single factor in the incidence of infection. The relationship of sepsis to depth is shown in Chart I and bears out that sepsis bears a direct relationship to the degree of burn. The mortality figures are also in keeping with it.

**Area :—**A study of Chart 2 shows an equally direct relationship of sepsis to area; the highest peak of infection being in the '10—20%' group. Burns involving larger areas naturally tend to die of shock and pro-

tein loss before sepsis has had time to develop and the incidence of sepsis rapidly falls in larger areas groups. The relationship of area to shock production is seen in Chart 15. Mortality figures are also appended. Chart II(a) shows the relation of blood protein levels to area.

**Contamination :—**Chart 3 of this series shows that the incidence of sepsis is much higher in the so-called clean cases (53%) than in the contaminated ones (38%). This paradoxical finding is in consonance with the opinion of other workers (Cope 1943, Meleney 1945) and serves to show that the surgical principles of wound treatment cannot be applied to burns as to other soft tissue wounds. Every case of burn whether clean or dirty has to be accepted as contaminated in the strict sense. The development of infection is inherent in the very nature of the burn injury as the main bacterial contamination comes from within the burnt skin and not so much from extraneous sources.

**Duration :—**The interval of time that elapses between the accident and hospitalization and treatment is of paramount importance in most wounds, e.g. compound fractures, and the question of debridement is closely associated with this time interval. In studying Chart 4 showing the relation of sepsis to the time interval, though one notices a gradual increase in the incidence of sepsis with later admissions, the rise is neither considerable nor significant. In fact it is somewhat erratic and tends to fall in the '12—24 hour' group after having risen in the earlier series. While the '24 hour and later' group shows a rise again, this is probably due to the introduction of secondary contamination in the later duration groups and is therefore irregular. This, to some extent supports what has already been said about the rationale of early debridement or debridement itself which appears to be of doubtful nature when applied to the treatment of burnt surfaces.

**Site :—**(Chart 5):—Certain sites appear to invariably get infected, e.g. perineum,

back and chest. The 100% incidence of infection in perineal burns needs no explanation and is to be expected no matter what prophylactic measures are used. But infection in areas of the back and chest (very high in the present series) can be prevented by use of sterilised bedsheets, cover etc.; and frequent changes of these as also frequent changing of the patients etc. Unfortunately this was not possible in most cases, as this entails constant and diligent individual nursing supervision as is not obtainable in a general hospital. Incidentally it may be noticed that the trunk area burns have the lowest incidence and the largest mortality.

*Agent (Chart 6):*—A study of this factor throws an interesting sidelight on the question of infection in burns. All other factors being equal, probably depth alone determines the onset of infection; and in Chart 6 which sets out the relationship between the agent causing the burn and infection, this fact is borne out. The incidence of sepsis in flame burns is much greater than scalds though their incidence is nearly equal. This is obviously due to greater penetrating effects of flame and consequent greater and deeper tissue damage. Those sustained by burning petrol have the highest sepsis incidence; explained by the greater heat and longer contact with flame. Electric burns (usually deep) are notorious for tissue damage and slow healing; they also not unnaturally are more prone to infection.

*Factors in treatment:—Debridement.* In this connection a comparison of the figures obtained from the study of another consecutive series of 120 cases treated in the same hospital with those of the present series is illuminating. The figures are quoted below. (Table I.)

TABLE I

Incidence of sepsis (total). Debrided cases—48.3%.

Incidence of sepsis (total). Non-debrided cases—36.8%.

Incidence of mortality (total). Debrided cases—18%.

Incidence of mortality (total). Non-debrided cases—15%.

Average healing time. 22.6 days in debrided cases.

Average healing time. 15.4 days in non-debrided cases.

Earlier in this paper the reasons for the non-suitability of debridement as one of the cardinal principles of burn treatment have been enumerated. These figures are in accord with such a view. Even assuming that in the two series different factors may have operated in the ultimate incidence of sepsis it has to be at least conceded that debridement had done no positive good if not any actual harm.

*Local Application:*—In the main two types of agents are usually used in the local treatment of burns; tanning agents with or without antiseptics or chemotherapeutic drugs (e.g. tannic acid, silver nitrate) and emollients such as petroleum jelly, various ointments with vaseline, codliver oil or gelatin base, again with or without antiseptic or chemotherapeutic drugs. Other agents such as electrolytic chlorine, chlorophyll etc., are either for special types or sites or still in the experimental stage. It is not the purpose of this paper to evaluate the merits of the various agents of local therapy and since the use of tanning agents entails the removal of blisters and a certain form of cleansing before the tanning agent is applied, only oily or gelatin based emollients were used directly applied without debridement. A compression bandage was employed wherever possible but again as the proper application of pressurized dressings required constant expert nursing supervision and adequate supplies of elastic stockinet type bandages—both of which were lacking, this part of local treatment was not satisfactory. Three local agents were used; sterile vaseline (Petroleum Jelly), Propamidine Jelly (May & Baker) Sulphanilamide 10% emulsion in codliver

oil. The incidence of sepsis with different local agents is shown in Chart No. 7; also vide Tables II & III. The lowest incidence was with the use of local sulphanilamide.

tion while general exhibition of sulpha does not. That the beneficial effect of sulpha in this series is mainly local and not dependant on general absorption from the burnt sur-

TABLE II  
Comparison of Sulpha & Non-Sulpha treated cases and control in Sup. and Deep Burns.

		Superficial					Deep				
		No. of cases	Percent Infection				No. of cases	Percent Infection			
			Mild.	Mod.	Severe	Total		Mild.	Mod.	Severe	Total
No Sulphanamide	...	19	16	16	0	32	36	0	36	11	47
Sulphanamide	...	66	9	10.5	16.5	36	39	12.7	17.7	20.0	50.4
Only general	...	13	15	22	30	67	13	15	15	15	45
Only local	...	50	8	8	12	28	25	12	20	24	56
Local & General	...	3	0	0	33	33	1	0	0	0	0

Sulpha treated cases 2.86% mortality.

Non-drug treated cases 5.5% mortality.

TABLE III  
Percentage of infection associated with different forms of local treatment in non-drug treated burns.

		No. of cases	Superficial				No. of cases	Deep			
			Percent Infection					Percent Infection			
			Mild.	Mod.	Severe	Total		Mild.	Mod.	Severe	Total
Vaseline	...	7	14	0	0	14	5	0	0	60	60
Propamidine	...	17	18	18	6	42	27	8	48	16	67

The composition of sulpha ointment used was as follows:—

Sulphanilamide	12 parts (about 10%)
Calcium oleate	2 "
Beeswax	3 "
Codliver oil	60 "
Water	40 "

Propamidine, one of diamidine group of chemotherapeutic drugs recommended because of its low toxicity from surface absorption, has a lower incidence of infection than vaseline, but the figures for vaseline are probably not statistically significant, the number of cases in that group being small. Propamidine jelly was mainly employed in this series as a control against local sulpha-therapy instead of sterile vaseline, which was discontinued early during this inquiry. According to Meleny's (1945) exhaustive enquiry the use of local sulpha appreciably reduced the incidence of infec-

tion while general exhibition of sulpha does not. That the beneficial effect of sulpha in this series is mainly local and not dependant on general absorption from the burnt surface is shown in Chart 7 (a). The estimations of blood sulpha level was done in 29 cases while local sulpha alone was used and in most 2 or 3 estimations were done at 2 or 3 day intervals. Average figures of these estimations have been used in the making of the Chart 7 (a). The absorption is shown to be erratic but bears some relation to the area of burn. The levels are quite low—not enough for general therapeutic effect but the highest recorded level (only 1 case) was 16 mgms. No cases of sulpha-poisoning were recorded. Evans & James (1945) carried out experiments which indicate that toxic absorption of sulphonamides from oil base ointments is rare. Toxic blood levels are commoner when water dispersible bases or direct application of sulpha crystals was employed.

*Chemotherapy*:—When this enquiry was initiated penicillin was not available freely—as such only sulpha-drugs have been used

Chart 1.

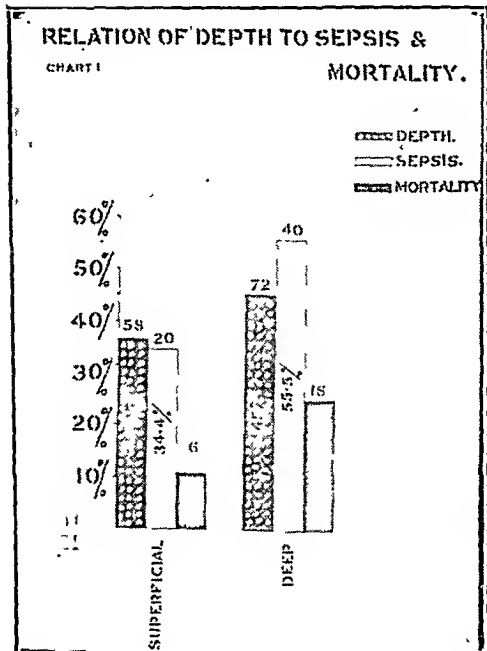


Chart 3.

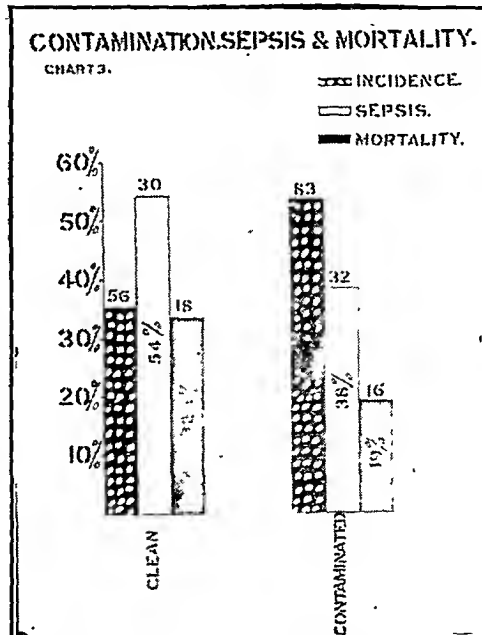


Chart 2.

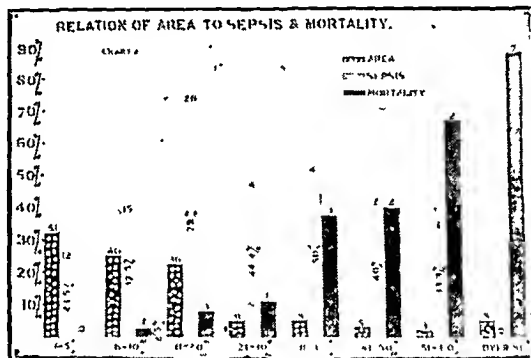


Chart 2-a.

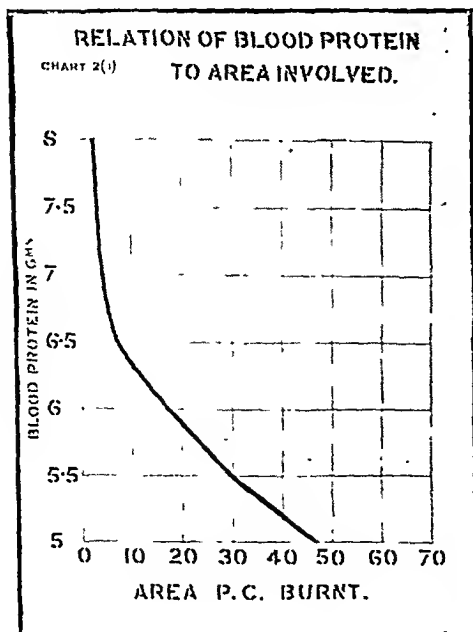


Chart 4.

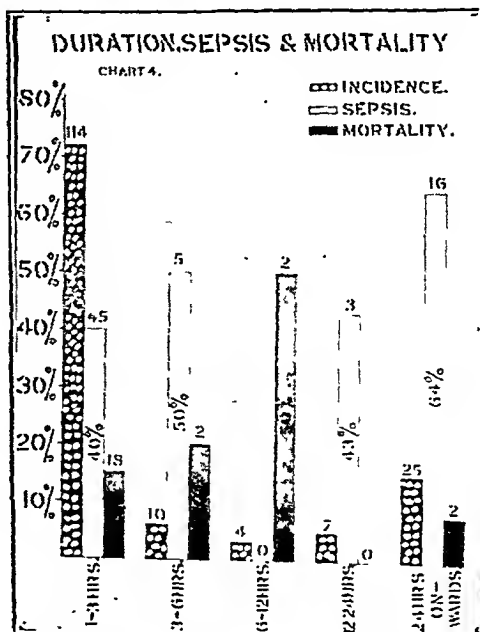




Chart 5.

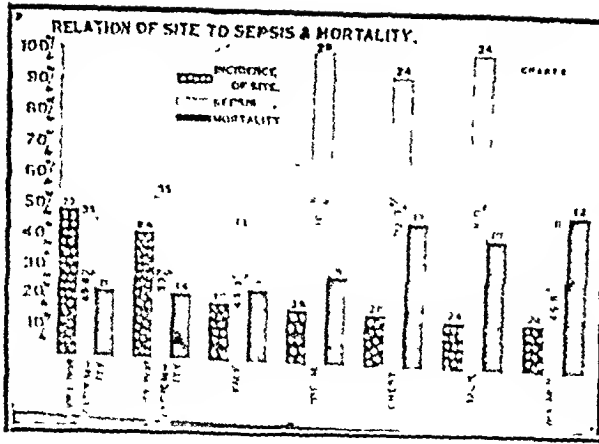


Chart 7.

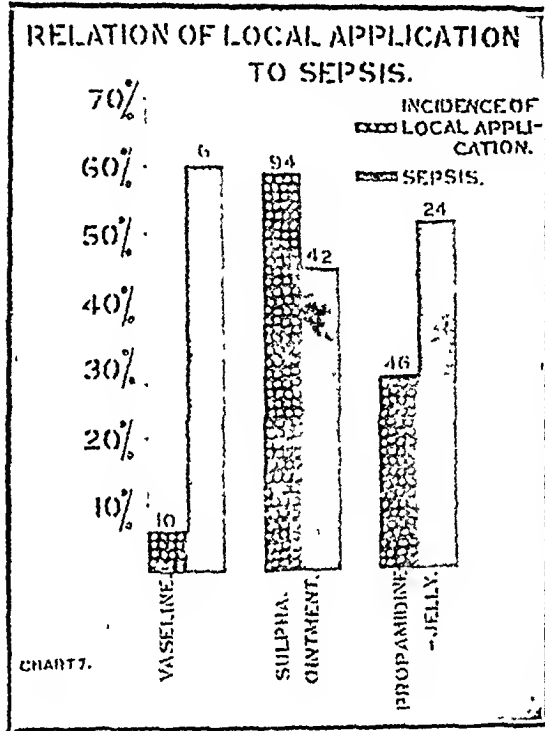
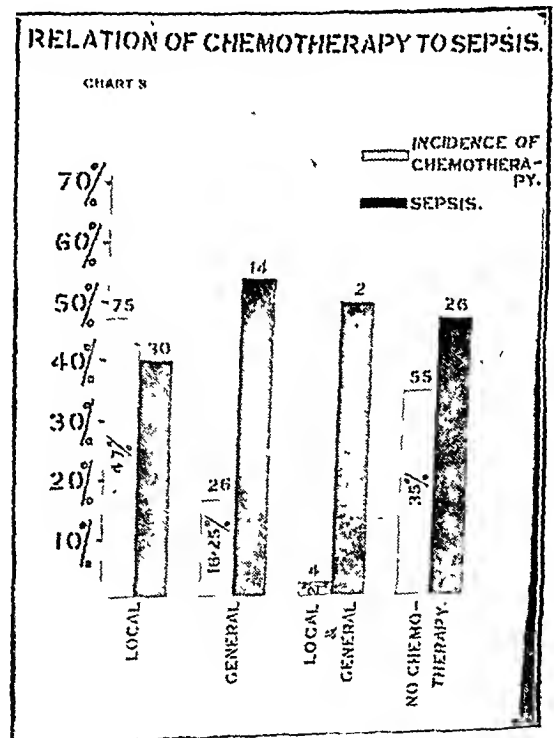
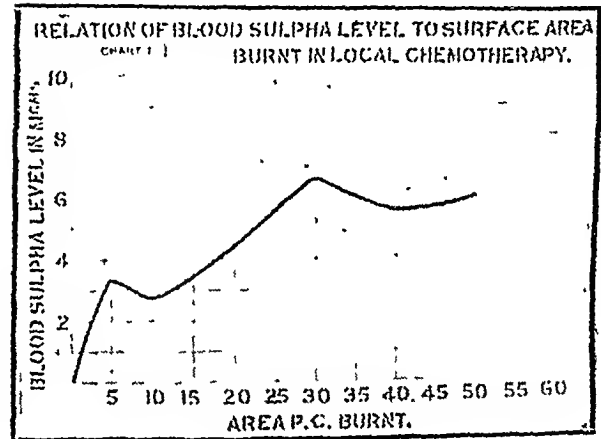
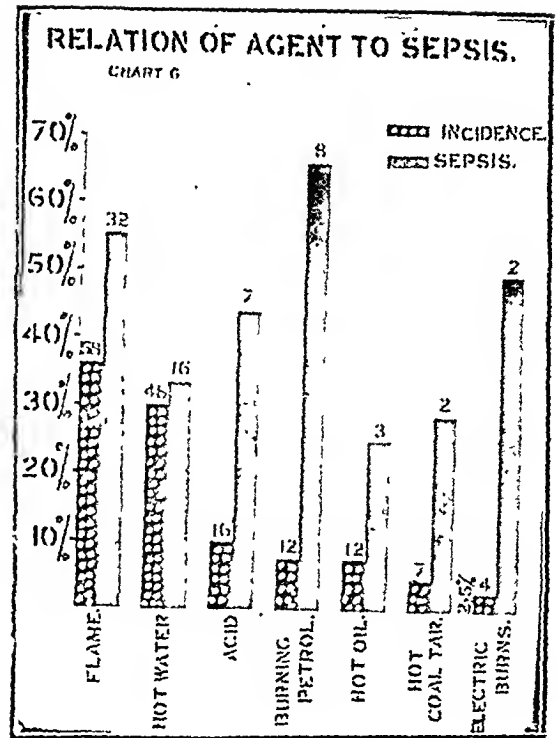
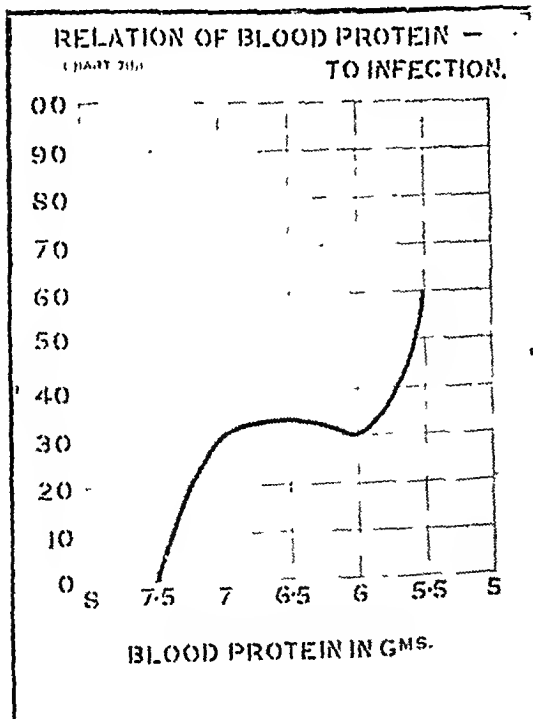


Chart 7-b.



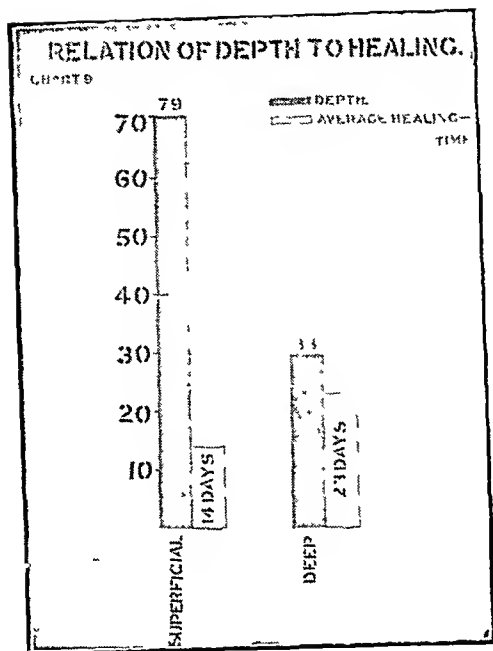


Chart 9.

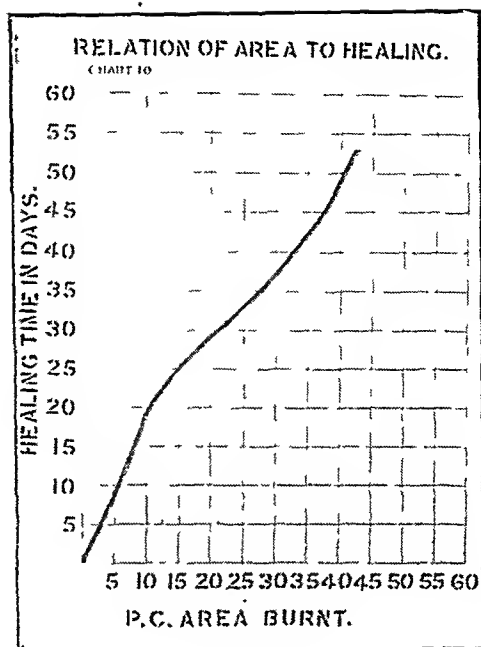


Chart 10.

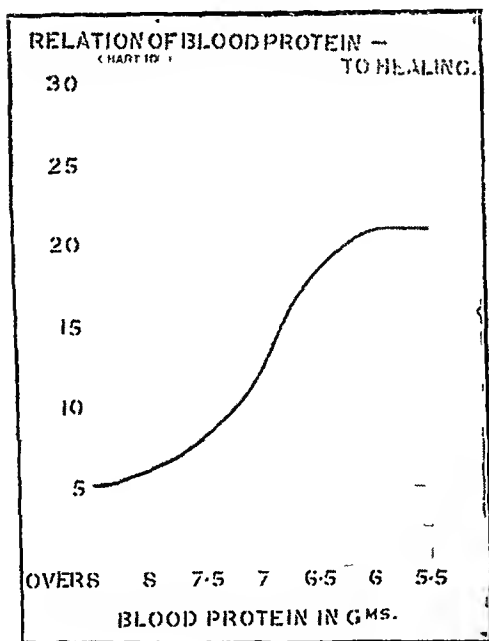


Chart 10-a.

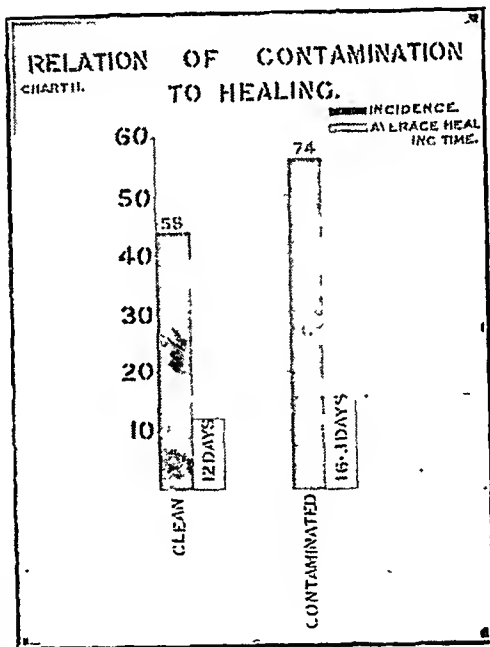


Chart 11.

Chart 12.

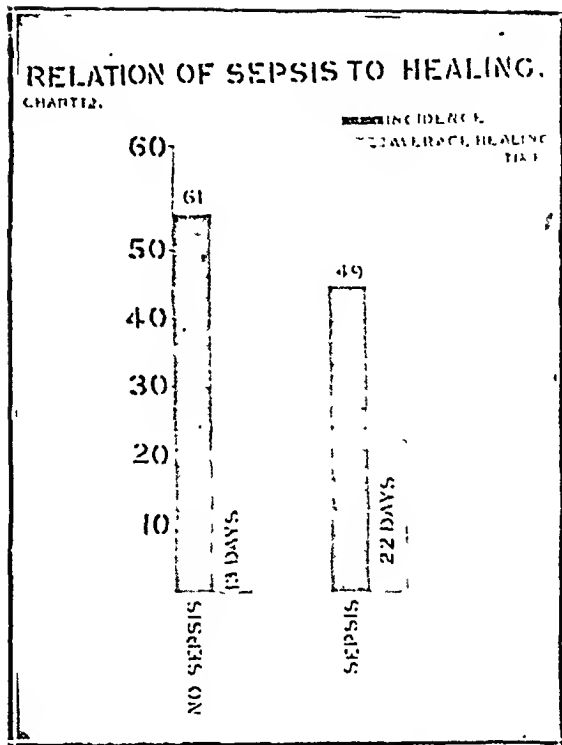


Chart 13.

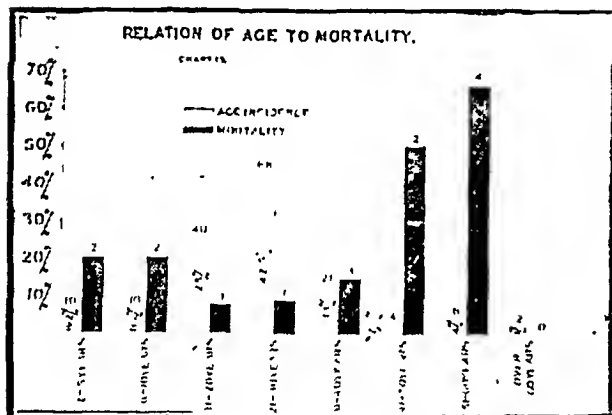


Chart 14.

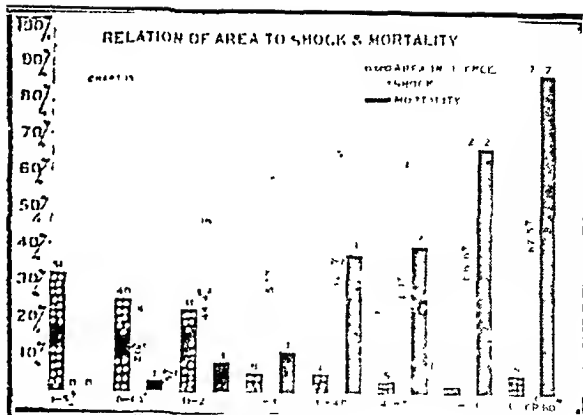
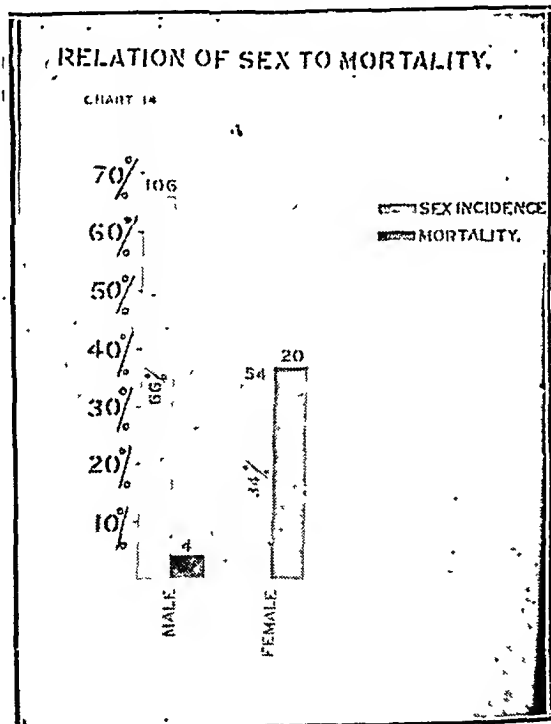


Chart 15.

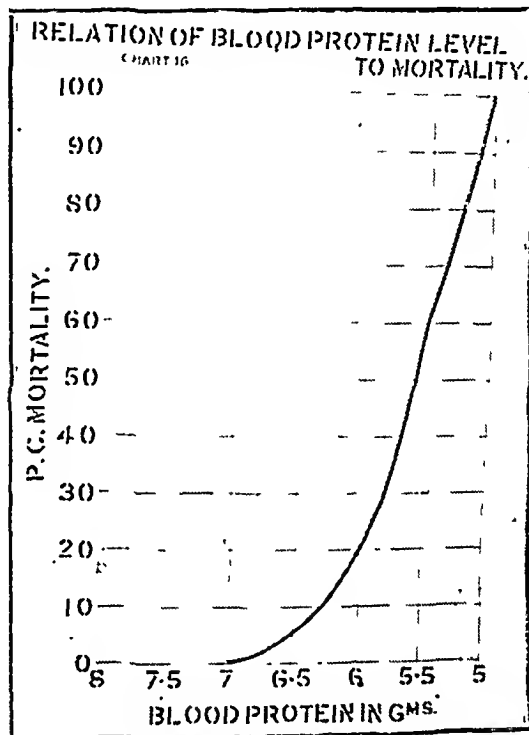


Chart 16.

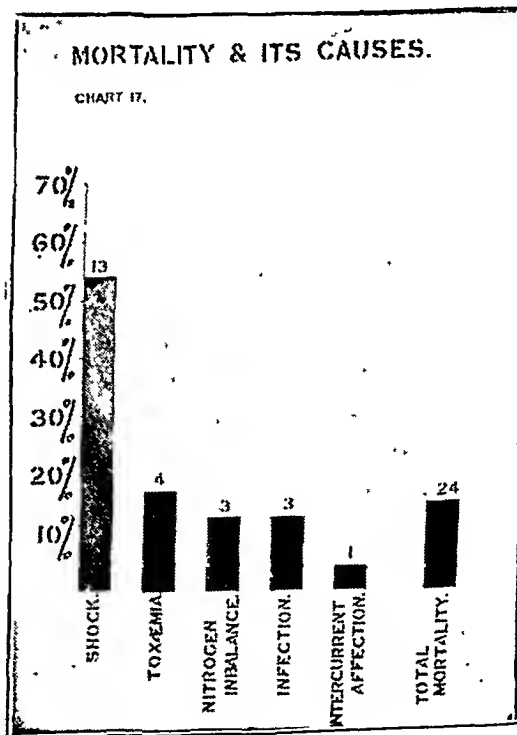


Chart 17.

in the series. The analysis of the effect of such chemotherapy in preventing or controlling sepsis are set out in Chart 8 and Tables II and IV. In determining both the

### Biological Factors

*Bacteriology* :—Swab cultures from the burn surface were made in more than a third of the series—the more serious being

TABLE IV

Time of onset of infection as correlated with the use or non-use of sulfa treatment.

		No. of cases	Percent incidence	5 days or less	Percent of Infection		16 days onwards
					6-10 days	11-15 days	
Control cases							
Total	...	26		62	31	7	0
Mild	...	4	15.4	75	25	0	0
Moderate	...	18	69.2	55.5	33.3	11.2	0
Severe	...	4	15.4	75	25	0	0
Sulpha treated cases							
Total	...	46		41	50	4.5	4.5
Mild	...	10	21.6	60	30	10	0
Moderate	...	16	34.8	19	73	8	0
Severe	...	20	43.6	50	40	0	10
Control & Sulpha treated cases							
Total	...	72		48.4	43	5.6	2.8
Mild	...	14	19.4	64	29	7	0
Moderate	...	34	47.3	38	53	9	0
Severe	...	24	33.3	53	36	0	11

incidence and time of onset of infection the use of sulpha-drugs seem to have played very little part. Only the local use of sulpha shows a somewhat significantly low incidence figures of sepsis (Table II). The use of general sulpha alone is attended with a very high incidence of sepsis while general + local sulpha has had no better effects though this group is too small to be statistically significant. There is no definite indication from this analysis that infection in sulphonamide treated cases was either prevented, delayed or even less serious than in the non-drug treated cases. The case for the use of local sulphanamide however has been made out. These findings are in complete accord with those of Meleny (1945) in his analysis of 591 cases. But in spite of the apparently questionable value of sulphanamides in the prevention of local sepsis there were only 3 deaths from sepsis in the sulpha treated, 105 cases—a mortality of 2.86% as opposed to 5.5% mortality from sepsis in the non-sulpha treated group. This fact is also noted by Meleny.

chosen for this purpose. Anaerobic cultures were not done. In general, swab culture from a surface is inadequate and even cultures of whole dead tissue removed cannot reveal with any certainty all the organisms in a given case. But the results even with these limitations are interesting and are appended in Table VI.

*Blood Protein Studies* :—It is now becoming increasingly clear in the light of modern research by Cotui and others, that plasma protein loss through and into the burnt area and attendant nitrogen imbalance determine to a great extent the development of late toxæmia in burns. This 'white haemorrhage' as it is called leads to hypoproteinaemia and in its turn to poor fibroblastic reaction and slow healing in which a vitaminosis, particularly deficiency of vitamin C also plays a part. The relation of blood protein levels to healing and mortality in this series are shown in Charts 10 (a) and 16 is at once apparent.

While the part played by protein loss and nitrogen imbalance has been clearly esta-

TABLE V  
Major factors in the incidence of infection following burns (Summarised).

		Totals	Percent Infection			Total %
			Mild	Moderate	Severe	
Superficial & Deep	...	130	7	20	20	47
Superficial only	...	58	8.7	18.9	12.2	34.8
Contamination	...	104	10.7	15.6	14.8	41.1
Clean	...	56	9	25	19.8	53.8
Area over 10%	...	69	10	23	28.6	61.6
Area less than 10%	...	91	11	14.5	4.5	30
Shock	...	52	15.4	23	29	67.4
No shock	...	108	11	7	4	22
No Sulfa	...	19	16	16	0	32
Sulfa	...	66	9	10.5	16.5	36

TABLE VI  
Bacteriological Studies

Organism	Primary culture	No. of cases of sepsis	Subsequent culture. New organisms
St. albus	...	45	20
St. aureus	...	35	21
Diphtheroid	...	7	5
B. subtilis	...	3	2
Gram positive bacilli	...	1	1
Streptococci	...	1	1
B. pyocyaneus	...	0	0
Gram negative bacilli	...	0	0

blished in relation to healing and mortality in burns the same cannot be said of the relation between blood protein levels and development of infection. In Chart 7 (b) such an attempt has been made. The total number of cases in the series 29, is too small for this to be statistically significant, but it is interesting to note, for what it is worth, that the incidence of sepsis rises steeply as blood protein level falls below 6 grams per cent. This roughly tallies with the protein level mortality chart (No. 16).

The major factors in the incidence of infections have been summarised in Table V. Permutations of all the factors would have been impossible and only those of direct import have been included.

**Healing** :—Almost all the factors concerned in the production of sepsis are some directly, and some indirectly, concerned with healing. For the purpose of correlation, the influence of these factors on healing as measured by average healing time

have been set out in Charts 9, 10, 10 (a), 11 and 12.

The final results have been graded as under in Table VII :—

TABLE VII

Grade I (complete epithelisation, no contractures) — 117 cases — sepsis 50; mild 17; moderate 22 & severe 11.

rate contractures)—2 cases—sepsis 20; both moderate.

Grade III (Fibrosis and severe contracture)—1 case—1 sepsis severe.

**Mortality** :—Charts 13, 14, 15, 16 show the relationship of certain factors to mortality not considered so far. The high death rate amongst females is significant and is probably explained by the type of accident and the larger area of burns sustained by women (e.g. sigree and stove accidents, sari catching fire, suicides, etc.). In Chart 17

are summarised the immediate mortality factors. Shock accounts for a larger group (more than half) of the fatalities while infection was responsible for about an eighth of the total mortality. The problem of shock and its treatment is not within the purview of the present paper though one feels that with more energetic treatment this preventable factor in mortality could be considerably minimised.

Toxaemia and nitrogen imbalance (which are closely inter-related and should be considered together) was responsible for nearly 30% of the total deaths in this series. Not much attention has been paid to this factor in the treatment of burns till comparatively recently when Co Tui and his co-workers (1944) first drew serious attention to the nutritional aspect of burn therapy. Davidson as early as 1926 had noted a very marked rise in nitrogen excretion in burnt patients. Lucido (1940) Taylor and others (1943) showed an excretion of as much as 45 gm. of nitrogen in 24 hours in burns of about 40% of body surface. Such loss if continued soon leads to a serious degree of

hypoproteinaemia with all its attendant ills. Restoration of the nitrogen loss has been attempted in three ways—high protein diet, plasma or serum transfusion and administration of predigested proteins by mouth or by the vein. During the last six months attempts at a more detailed study has been made by us into this—the nutritional aspect of the burn problem. Only selected cases (between 10 and 60% of burnt areas) being used for this study. The work is still in its initial stages and so far only seven cases have been studied in detail. Most burn patients have neither the appetite nor digestive capacity for high protein diets and so intravenous plasma and oral case in (enzyme) hydrolysates have been used to restore blood protein values. A cheap variant instead of the costly hydrolysates is skimmed milk powder which has been used with advantage in a few cases. Larger amounts of skim milk powder however have a tendency to produce diarrhoea but the rise in blood protein has been encouraging. We hope to pursue this line of work further.

# BURNS\*

by MUNAWAR ALI.

## GENERAL TREATMENT OF THE PATIENT WITH SEVERE THERMAL BURN

### Introduction

Effective and yet simple treatment of burns is a problem of considerable value to most of the Surgeons in this sub-continent where facilities for elaborate treatment are not always available. In recent years many valuable contributions have been made to our knowledge of the Pathology and treatment of burns by numerous contributors. The purpose of this communication is to present some of the observations based on the clinical study of 347 cases of severe burns mainly treated at the Osmania Hospital, Hyderabad, Deccan. In this paper I have dealt with the common thermal variety of burns.

Various aspects of the problem of burns are discussed briefly and the practical question of treatment both early and late is presented in some detail. During the past few years as I became more and more interested in the early treatment of burn cases I must confess I became more and more conscious of my ignorance of the vast and varied problems of altered physiology, disturbed bio-chemical phenomena and a host of other things. The late treatment of burn cases with its vast problem of repair of ghastly and crippling deformities so commonly met with in this country attracted my attention considerably. A clear understanding of the physiological, bio-chemical and pathological features is the fundamental requirement for the intelligent treatment of burn cases.

Perhaps it is worth while to recapitulate the important physiological properties of the skin—the structure that bears the great brunt of the accident in burn cases. Skin is the most important protective organ covering the body, it is a barrier to the entrance of bacteria from the surface, it

exerts a strong, firm and elastic pressure of about 10 to 20 millimetres of mercury over the underlying structures, and it plays a vital part in the heat regulation of the body. The fluid secretion of the sweat glands is about  $1\frac{1}{2}$  pints a day. Secretions of the sebaceous glands provide an oily coating to the skin.

### Pathology

*Local:* There is great tissue destruction by the causal agent at the time of the accident. Thermal bombardment of the tissue may stop completely after a short time of 30 to 40 seconds, yet a regular chain of processes may extend over hours or days, liberating substances from the damaged cells which are responsible for local oedema and leucocytic infiltration of the region. This autolysis goes on and the process is severe and prolonged in the presence of infection. Thus it is evident that the presence of infection can easily convert a comparatively slight damage into a serious one when burned tissues break down and liquify and flood the body with toxins.

From the damaged and broken skin some serum weeps out, but enormous quantities of plasma are lost from the circulation into subjacent tissues—underneath the burned area—and some around the burn. There is not much evidence to show that there is any appreciable loss of plasma in areas of the body distant from the burn. The most striking feature of a burn is the intense local oedema which sets in very rapidly in less than an hour or two.

It has been demonstrated by numerous workers that this effusion is plasma, except in deep burns where the loss may include blood as well.

If this plasma fluid in, around, and underneath the burn is not returned to the circulation (this can be done to some extent by

\*A paper read at the Annual Conference of the Association of Surgeons of India, Dec. 1947.

early elastic pressure bandaging) it will settle down and coagulate. This may become one of the important factors responsible for the production of excessive fibrous tissue during the healing stage.

*General Pathologic Physiology:* Every severely burnt patient passes through the following phases of disturbed physiological conditions:—

1. *Primary Shock (Neurogenic Shock):* May be absent in severe cases. This is perhaps to a great extent due to associated psychological trauma from fear and anxiety, as it was not much in evidence in service cases during war. Relief of pain by

This phase is instantaneous, transitory and of little clinical importance. Now the patient becomes calm and restful, with full bounding pulse and quiet respiration. This may deceive one from the dangers yet to come. The primary shock accounts for about 2 per cent of the fatalities.

2. *Secondary Shock (Burn Shock or Vasogenic Shock):* This may be expected to develop, if the burn involves 5 to 8 per cent of body surface in children and 12 to 15 per cent in adults, and if not prevented. Symptoms of burn shock become apparent when blood pressure falls to 80 mm. hg.;

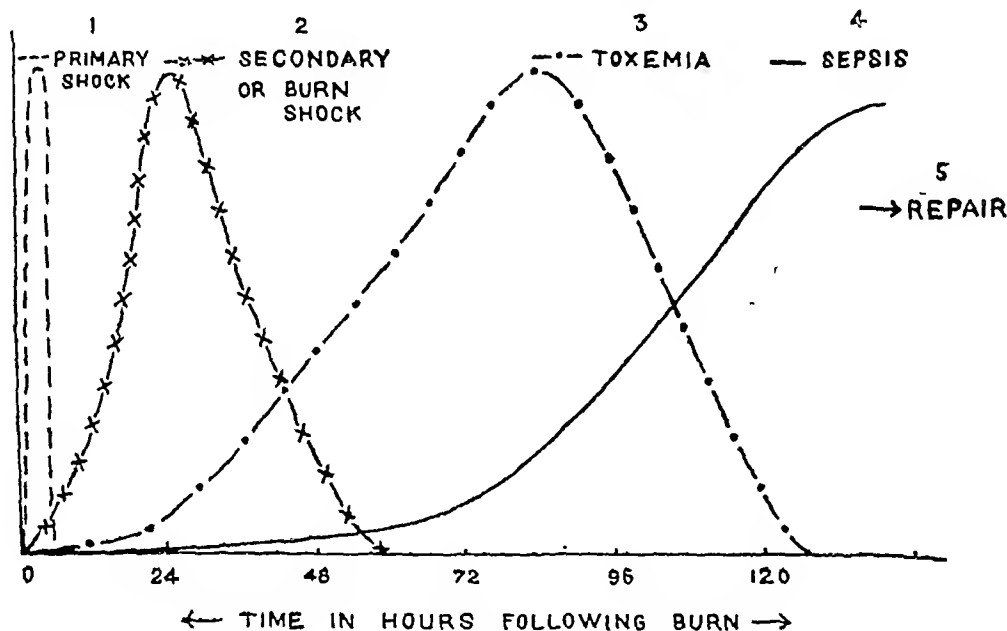


Fig. 1. Modified chart showing overlapping occurrence of the various states in severe burn (after Wilson).

morphia considerably lessens the primary shock. There is acute vasomotor paralysis from excessive stimulation of sensory nerve endings in exposed burnt areas. This pathologico-physiological process manifests itself in the well-known clinical picture of the burned patient lying prostrate, pallid, cold, with sub-normal temperature, rapid pulse and low blood pressure.

signs of collapse of the circulation ensue if it further falls to 60 mm. hg.

Blood pressure readings are of value in the estimation of the degree of shock; nevertheless they cannot be implicitly relied upon, as not infrequently one meets with cases of burn shock where blood pressure instead of being low may be normal or



in rare cases even high. Hence the importance of judging shock clinically. In this stage a patient, though alert mentally, has an anxious expression. He is pale and collapsed, skin is cold, pulse rapid and thready, respiration is quick, temperature sub-normal, and blood pressure is low and the urine scanty.

*Causes :* (a) It is due to great plasma loss from the circulation but not much from the body itself. It is mainly due to abnormal distribution—the plasma is lost in the body itself, in the tissues underneath the burnt area. It has been calculated that in the case of burns involving one-sixth of the body surface there might be as much as 70 per cent reduction in the circulating volume. It has to be appreciated that one pint of plasma lost to the circulation is more serious than a loss of one pint of blood. Plasma loss reduces blood volume and does extra damage by haemo-concentration while blood loss only reduces circulating volume. Therefore plasma loss actually should be more dreaded than a corresponding amount of haemorrhage. Further, the human body only has plasma in a quantity which is half the volume of blood and consequently can spare plasma less.

(b) There is pooling of blood in the capillary bed with increased permeability due to factors not yet fully known—perhaps due to absorption of products of tissue destruction and also due to loss of elastic pressure exerted by the intact and undamaged skin.

Loss of plasma produces increasing haemo-concentration, decreases circulating blood volume, lowers cardiac output, lessens the blood flow, and there is a secondary fall of blood pressure and secondary vaso-constriction. Therefore there is inadequate circulation to the whole body. There is inefficient oxygen carriage, starvation of tissues, irreparable damage to the organs of the body, fall of temperature and finally suspension of vital activities.

Damage to the liver as a result of burn shock must be well-appreciated. Failure of

the kidney resulting in oliguria and anuria occurs after the liver has been overwhelmed. Circulation to the kidney may be so retarded that renal function is almost or entirely stopped, and excretory products accumulate. If renal blood flow is cut off for a few hours, the kidney cells may be so injured that they never recover, and even if the general circulation is restored death in uraemia follows some days later. Therefore it is important to restore circulation promptly and in time.

3. *Toxaemia :* In this stage a patient may be irritable and distressed, complains of headache, and has a rapid pulse, elevated temperature, nausea and vomiting, loss of appetite, and a poor urinary output.

The toxaemia of burn is a widespread process involving many if not all the organs and tissues of the body. Toxaemia in an uninfected case is comparatively mild or absent. The nature of the toxins is still in undecided question. What are the products of cellular disintegration that are toxic to the body? Are they histamine like substances or protoenzymes? It is possible that enzymes or other substances liberated from damaged tissues but not coagulated by heat, towards the periphery of a severe burn, may themselves act as poisons.

*Causes :* Davidson has pointed out that there is alteration in blood chemistry as in the toxaemia of intestinal obstruction. He believes sodium chloride depletion plays an important part in the production of burn toxaemia. Blood chloride estimations are low, urinary excretion of chloride is also less, while chlorides are in abundance in oedema fluids at the burned area.

There is a marked similarity between the symptoms of adrenal deficiency,—low blood pressure, high haemoglobin concentration, low blood chlorides, anhydraemia, and occasional intestinal ulceration—and toxaemia of burn. Whether the toxaemia is partly due to the lack of adrenal cortical hormone in the circulation is still a matter for speculation. Swelling and haemorrhagic enlargement of suprarenal glands with focal necrosis are constant features at autopsy.

Damage to the liver, both functionally and histologically is usually mild if tannic acid is not used in the local treatment of burn. The liver also loses power to synthesize glycogen from glucose.

Damage to the kidney in the form of toxic nephrosis is a constant feature in fatal cases of burn.

### *Pathology of Repair of Burn*

This does not differ from the repair of any other accidental wound. Epithelial regeneration proceeds from the edge of the burn and from the islets of epithelium left on the bare surface—and from this epithelium differentiated structures of epidermis are formed. Repair of the dermis is in the usual way through the formation of granulation tissue and fibrosis with scarring.

Excessive necrotic tissue may hold up repair and prevent early elimination of infection.

Among the curative agents in the treatment of burn tannic acid produces some tissue damage and delays healing, the least toxic agents being sulphanilamides and penicillin.

### *Classification*

The well known Dupuytren's classification, over a century old, serves no useful purpose from a practical point of view and is now being discarded all over except for its historic interest.

Wakely has suggested a very simple classification of superficial and deep burn—superficial involving partial skin loss including the first three degrees of Dupuytren,

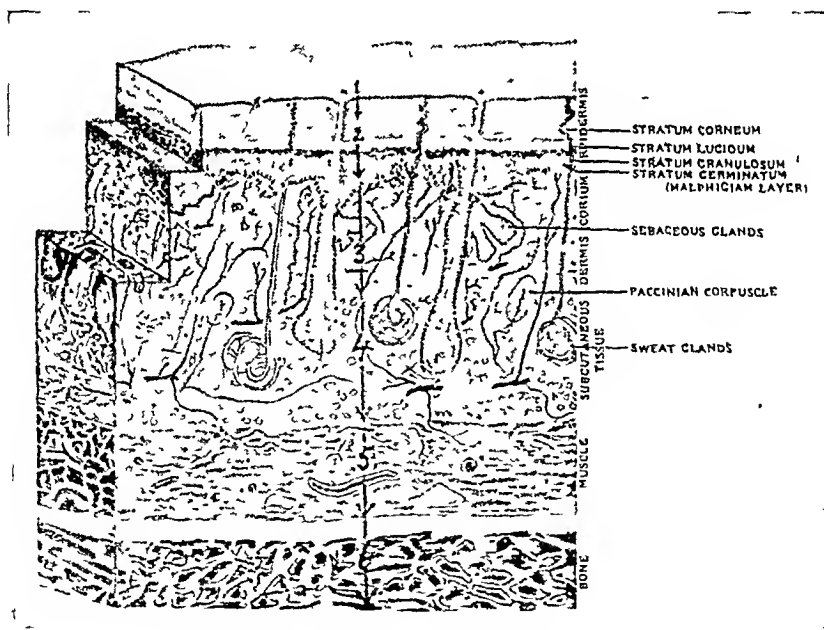


Fig 2 Diagram representing classification of Burn

The arrows indicate the depths of Burn according to Dupuytren's classification.

The steps on the left represent the depths in the modern classification

1 Superficial—1st degree    2 Superficial—2nd degree    3. Deep—3rd degree.

and deep burn involving complete destruction of the skin and even the deeper structure corresponding to the last three degrees of Dupuytren's classification.

From the clinical, therapeutic and prognostic points of view, taking into serious consideration Lehman's suggestion I have been lately classifying my cases in the following three clinical types:—

1. *Superficial*—1st Degree: The destruction extends down to but not involving germinal cells in the Malpighian layer. This may occur with or without blistering. It corresponds to the first and second degrees of Dupuytren's. The reason for combining the two degrees under one head is that there is little difference in treatment and none in prognosis. Further it can be clinically recognised on first inspection. In case of blistering, on the removal of blistered skin there is uniform redness or erythema in this degree.

2nd Degree: This corresponds to the third degree of Dupuytren's classification. Clinically in this degree, on removing blisters alternating red and pale areas give a recognisable mottling appearance. Clinicians have always considered this degree as a special entity. In this degree epithelium of the hair follicles, sebaceous and sweat glands is spared providing an opportunity for healing with patchy regeneration of epithelium and patchy scarring, as nowhere does the loss include the full thickness of the skin. It does not require skin grafting. Further, in this type sensory nerve endings are mostly exposed and therefore it is a most painful variety. This group requires protection from further damage by infection which may gradually destroy the epithelial remnants in the hair follicles, sweat coils and sebaceous glands.

2. *Deep*: This corresponds to the last three degrees of Dupuytren's classification. Clinically in this degree blisters are not always present and the appearance of the burnt area is one of dead-white pallor. In this type as the nerve endings are des-

troyed pain is less. Except those due to hot metal or some such thing, it is rare for any patient to have a deep burn without a surrounding area of second degree damage. It is often difficult and sometimes impossible to decide the true depth of destruction until the sloughs separate.

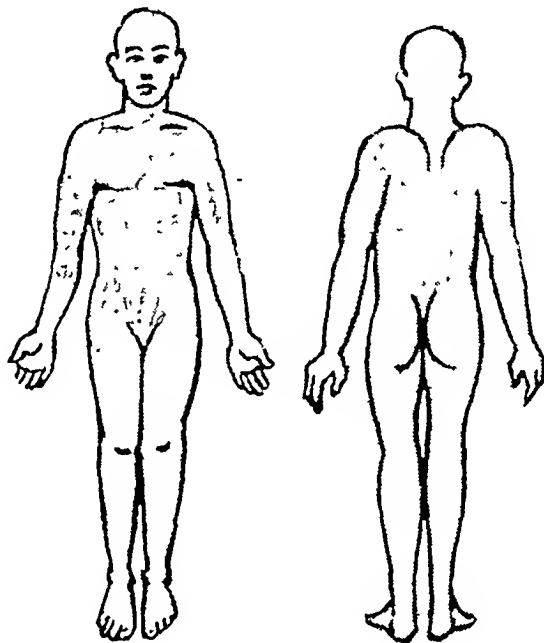


Fig. 3.

A chart for recording the extent of burn, using Berkows scale for estimating the extent:—

Head & Neck	6%	Anterior	20%
Trunk	38%	Posterior	18%
Upper extremities	18%	Arm & Forearm ( $\frac{3}{4}$ )	13½%
		Hand ( $\frac{1}{4}$ )	4½%
Lower extremities	38%	Thighs ( $\frac{1}{2}$ )	19%
		Legs ( $\frac{1}{3}$ )	12-2/3%
		Feet ( $\frac{1}{6}$ )	6-1/3%

Considering the fact that the extent of burn is more important than its depth, it is best that burns are classified by a combination of both depth and extent.

In estimating the extent of skin involved. Berkow's method is simple and practical and has been adopted (e.g. (1) 23 per cent

superficial 2nd degree burn, (2) 41 per cent superficial 1st degree and 25 per cent deep—mixed burn).

### Treatment

With a somewhat better understanding of the pathology of burns, it is possible to lay down definite principles regarding the general treatment. Our aim and object should be to save life, to combat shock, prevent toxæmia and infection, eliminate, or at least, minimise scarring, prevent contractures and deformities and restore normal physiological function of the body involved in the accident. There is considerable unanimity of opinion regarding the general treatment, but as regards local treatment there are many varied methods adopted by different workers, each claiming particular advantages for the method adopted, and still there is universal search for better methods. The last-mentioned fact shows clearly that this problem is far from settled.

#### First Aid Treatment.

It is suggested that only the exposed burn should be covered and the patient wrapped in sterilised or freshly laundered clothes and taken to the hospital as speedily as possible for proper treatment—this is the best that the First Aider can do. If speedy transfer of the patient is not possible, it will be of great value to apply firm bandages which will limit the plasma loss that occurs in considerable quantities within the first hour or two after accident.

Where some delay is inevitable saline compresses and firm bandaging as a first aid measure is simple, somewhat efficient and possible of application in most instances and in most places.

All this should be done with thoroughly clean hands, and handkerchiefs to the patient's mouth and nose and to those of the First Aider's.

#### General Treatment

As has already been pointed out, the burnt patient does not pass from one phase

to the other but these phases overlap and perhaps they all even start from the very beginning of the accident. It is therefore apparent that a good plan will be to adopt all necessary therapeutic measures from the beginning.

Some cheerful and hopeful words from the Doctor will go a long way to keep up the morale of the patient who has been shaken with a severe and alarming accident. Injection of anti-tetanic serum is given as a routine. In an adult one-third to half grain morphia is given with 1/150 to 1/100 grain of atropine. Atropine to some extent checks the fluid loss from sweating. It may also be of value in cases of pulmonary oedema which sometimes occurs in burn cases out of proportion to the area damaged by burn. In such cases atropine alone is repeated.

After the first injection of morphia if the patient is still in pain it is probably due to failure of absorption of the drug in a shocked patient. To repeat morphia is to invite the grave danger of sudden absorption of the repeated, accumulated doses when shock abates and circulation improves. Some patients may be restless but are not in actual pain and often an urge to repeat morphia in these cases is erroneous.

The ill-conceived idea of keeping the shocked burn patient, as a routine, warm by many blankets with hot water bottles between, or by electric cradle, is to be condemned. We really aim at preventing further heat loss from chilling and checking outside cold having bad effect. There has been a tendency in the past to over do it. If you heat up your patient, at a critical time like this, more than half a litre of blood, so desperately needed by the body and vital centres, will flow to the skin where it would be lost causing further reduction of circulating volume—it might also lead to further fluid loss by sweating. The accepted practice of today is to keep the temperature of the burn-tent below the body temperature.

The burnt patient should receive fluid by mouth whenever he can take. This is only possible if the patient is not in severe burn shock. To give food and large drinks of any kind till the stomach is retentive, a condition that is generally obtainable only when the phase of shock has passed off, is to cause more and more fluid loss in vomiting. Even before the phase of burn shock is over, as soon as it is under control, oral fluids specially physiological electrolyte solutions are of great value as adjuncts.

As 80 per cent of the fatalities of burns are due to burn shock, prompt and effective treatment to save life should be our first and foremost object.

To combat and prevent burn shock, plasma transfusion is ideal and most logical. There is definite evidence available that the fluid loss from circulation in, under, and around the burnt area is plasma. All other substitutes must therefore be considered inferior.

In place of plasma, as inferior substitutes, bovine albumin, gelatines, and other synthetic colloids can be used.

Lately, however, there is growing evidence to show that in deep burn, loss of blood may equal or even exceed plasma loss. Therefore it is logical to give blood transfusions with equal quantities of plasma or normal saline in deep burn, a procedure that will fulfil the requirements better than plasma alone.

I must confess that due to poor supply only a few of our patients received plasma transfusions, and rarely anything like adequate quantities. Knowing full well the dangers of intravenous normal saline infusions during burn shock which might tip the balance against the patient by washing out the plasma proteins from the circulation into the damaged tissues, we have reluctantly used as a poor substitute for plasma ascitic fluid whenever available; and 6 per cent gum saline in other cases. The damaging effects of gum on the liver are not forgotten. Low content of protein in the

ascitic fluid has also not been lost sight of. In a few cases where we have used ascitic fluid, results have been satisfactory and I had not the occasion to regret its administration. Intravenous saline infusions are not recommended during shock, because they not only run right through the injured capillary walls but may also carry valuable blood constituents with them, leaving the blood more concentrated in red cells and lower in plasma volume than before.

In severe burn a rapid transfusion of about 500 c.c. of plasma is given intravenously. Only in rare extensive cases sternal or tibial transfusions are resorted to.

The foot of the bed is raised, limbs are bandaged if possible to squeeze some blood from the peripheral to the internal circulation. I must not fail to emphasise that the total effect of these simple and trivial procedures is not to be overlooked in such cases. At this stage, as we shall discuss in detail later, simple pressure treatment of burn is instituted. This is an important effort to check as far as possible the peripheral leakage which would be occurring while plasma is being transfused into the circulation. This early and prompt local treatment by pressure dressing not only seals off the burnt area rapidly before much plasma loss has occurred and helps the prevention of shock, but also works hand in hand with the general treatment in maintaining normal blood volume.

Plasma by drip method is now continued until the volume occupied by red corpuscles in oxalated and centrifuged sample of venipuncture blood in the graduated haematocrit tube shows the normal value of 45, and the blood pressure rises to above 100 m.m. hg.

Out of the many methods of assessing the quantity of plasma, whose quantity certainly varies from hour to hour in burn shock, I adopt the simple method of giving 50 c.c. plasma for every 1 per cent of burnt surface.

It is most physiological and also in conformity with the established clinical practice of keeping a diabetic patient on such doses of insulin that the patient is slightly on the side of hyperglycaemia than hypoglycaemia, that I prefer slightly less than the adequate quantity, and let my patient be on the side of slight haemo-concentration which in turn is a good physiological stimulus for reabsorption of plasma from the subjacent oedema of the burn.

In cases of severe burn requiring massive plasma transfusions, there is danger of pulmonary oedema after about 36 hours when reabsorption of the illdistributed plasma fluid from the burnt area may start. It is for this reason that Muirhead has suggested the use of plasma 3 times concentrated.

While adopting above measures oxygen inhalations are started early to prevent anoxaemia and tissue starvation specially in suffocated cases and those with lung complications.

For the proper care of the burnt patients, as suggested by Harkins and his associates, it is advisable to adopt, as a routine, the following:—

- (1) Chart pulse, temperature, respiration every two hours.
- (2) Record blood pressure every two hours during the first two days and thrice daily (8th hourly) during next 5 days. More frequent readings are required if systolic pressure is below 90 m.m. hg.
- (3) Record daily fluid intake and output.
- (4) Examine the urine daily—this is of special value if sulphadiazine drugs are being used.
- (5) Examine blood for haematocrit index or haemoglobin percentage or red blood cell count—also total and differential count (to help detecting the untoward effects of sulphadiazine drugs). This is done every third hour during first 12 hours and once a day for a week.

Among other measures occasionally adopted, mention may be made of intravenous injections of Eucortone (adrenal cortical hormone) 2c.c. repeated at 2 hourly intervals. This is an adjuvant of doubtful value. It has little to offer in the treatment of burn shock or toxæmia. Rhodes, Wolff and Lee in 1941 published encouraging reports; but the same writers later, in a large series, noted no benefit from the use of adrenal cortical extracts.

**Prevention of Toxaemia:** whether of biochemical origin or due to toxins of infecting organisms, demands proper and prompt treatment. In the state of toxæmia parental administration of 500 c.c. of normal saline for a few days is useful to counter the low blood chloride values. If vomiting is present 2 to 3 per cent hypertonic saline intravenously by drip method will replace chloride depletion and arrest it. As the liver bears the brunt of the toxæmia, addition of glucose to intravenous infusions at this stage will help the liver to cope with the toxins that have flooded the body of the patient.

To guard against the bacterial toxins, we attempt to prevent infection by early and judicious use of the modern chemotherapeutic agents and by mobilisation of the defensive mechanisms of the body.

In our series of cases early and proper use of penicillin and sulphadiazine drugs gave good results by checking infection, and there was a considerable reduction in mortality.

With more patients surviving extensive and deep burns as a result of improved treatment, the question of anaemia of burn is assuming importance. It should be predicted and forestalled. It is due to external loss of blood, increased fragility and consequent destruction of red cells owing to widespread infection, and inhibition of the red cell regeneration as a result of toxæmia. Regeneration of red cells in a severely infected burn patient may be reduced to one-third of the normal. Further red blood cells of the transfused blood are also destroyed. Therefore repeated trans-

fusions alone will be of no use in the treatment of anaemia if infection is not prevented and dealt with at the same time. Pseudo-anaemia of haemodilution by reabsorption of plasma fluid from the oedema of burn occurs from third to sixth day and is due to increased plasma volume. This should not be mistaken for true anaemia. Hence the importance of correcting blood picture values with circulating volume.

During the healing phase not only anaemia but hypoproteinaemia and avitaminosis have also to be attended to. Excess of protein is required not only to meet the loss in exudate but also to cope with increased metabolism of fever in infected burn. Two-thirds of the sulphur in the body is estimated to be in the skin. For the proper repair of the skin in burn patients the value of sulphur containing foods like eggs cannot be over-emphasised.

Attention to the diet will have its own reward in rapid and early cure and better healing.

**Complications:** Toxic nephritis, toxic jaundice, septic Bronchopneumonia, and intestinal ulceration are the complications occasionally met with. They are becoming rather rare in burn cases in this anti-biotic era.

**Prognosis:** In determining the prognosis the extent of burn is far more important than its depth. While in the past one-third body surface involvement in adults and one-seventh in children usually proved fatal, at present due to better burn therapy even extensive burns involving 70 per cent or more of the surface may not be fatal. It is a well-known fact that children tolerate burns badly in general and of the chest and abdomen in particular.

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## LOCAL TREATMENT OF FRESH THERMAL BURN

*Local Treatment:* It is carefully correlated with general treatment and is executed concurrently with general treatment. In the early period a well-planned and properly and promptly carried out local treatment must aid the prevention of full establishment of shock.

I always had a feeling of great revulsion to the method of scrubbing of a burn patient. Certainly it is a most unphysiological attitude for a medical man and an unbecoming procedure for a modern Surgeon whose gentleness in the art of healing in other spheres of surgical practice has been the source of pride. Many a severely burnt patient whose life hung in the balance must have been tipped over by this procedure. It is gratifying that such a toilet and debridement of burn is now receiving universal condemnation. For many years I had performed a minimum of toilet and sparing debridement. The treatment of burn cases of the famous Cocoanut Grove disaster in November 1942 at Massachusetts General Hospital without cleaning and debridement provided moral support.

The burnt patient is laid over sterile sheets and is also covered with sterile towels. Medical attendants and the patient are all masked. Local treatment should be carried out with all the surgical cleanliness one requires for any major surgical operation, under morphia sedation only. Now run over a jet of warm normal saline over the burn area washing away loose dead tissue and at once dry with handkerchiefs wrung out in warm normal saline and gently pressed over the burn surface. Some more of the remaining loose dead tissues come out in this manner. I have never had occasion to regret not doing vigorous cleaning and thorough debridement. Thorough cleaning and debridement to my mind appear to be doing exactly the opposite of what it is intended for. In our attempt to clear the dead tissue, we cause more death

and damage locally, and a far greater damage to the patient in general by adding to his shock at a moment of grave crisis. We fail to eliminate infection and perhaps help the organisms to get into deeper layers and gain a foothold. In this way we interfere with the natural resisting power of normal skin cells and secretion. Only the healthy skin around the burn area is cleaned with rectified spirit.

The burn surface is frosted over with penicillin powder. Penicillin is mixed with any plain sulpha drug powder. 500 units of penicillin per gram of sulpha powder is a desirable dilution. Sulphonamide may be considered as a good diluent for penicillin rather than of any considerable value as local anti-biotic. Sulphonamides are valuable in suppressing the infection mainly due to the quantities absorbed into the blood from the raw burnt surface—a point that has to be borne in mind as large quantities used locally may produce alarming toxic blood levels.

When dealing with large surfaces in burns, I prefer to use penicillin in a cod liver oil and vaseline base, which is spread over evenly on vaseline gauze pieces and applied to the burn surface. I think the practice of spreading over penicillin ointment with a spatula over the raw surfaces should be discouraged as there is the possibility of infection being spread from one area to the other.

After frosting the surface with penicillin powder, I apply a couple of layers of cod liver-oilsoaked fine mesh gauze strips and a few layers of vaseline gauze are laid over. These, in turn, are covered by dry fluffy gauze and mechanic's cotton-waste, which act as good buffers and distributors of pressure. With all the care at one's command, and from below upwards, firmly and evenly, crepe elastic bandages are applied. Even when burns do not involve leg or forearm, bandaging should start from the tip of the extremities.



To prevent slipping of dressing, specially over the trunk, adhesive elastoplast is of additional advantage.

This non-adherent pressure dressing method popularised by Koch and practiced by us for some years is based on good surgical principle, although it requires meticulous care to be successful. It is a simple procedure and can be applied promptly and quickly before much of the fluid is lost, and is also a painless method. The common practice of the laity in applying oily substances as first aid measure does not interfere with the execution of this method. It is harmless, without any local or general untoward effects. It also aids in preventing and minimising further infection. As confirmed experimentally by Siler and Reid in 1942, it minimises plasma loss mainly by exerting pressure in the same way as the normal skin does and reduces capillary permeability of the tissue by raising the subcutaneous pressure, and to

some extent the oil with plasma on the burn surface produces a physico-chemical protective membrane. In this method most infrequent change of dressing prevents the constant danger of reinfection. It is a wise saying "Less often you dress a burn, faster it heals." It does not fix or destroy any viable tissue. It provides free and adequate drainage and prevents absorption of the septic exudate, if any, in the later part of the treatment. It can be easily removed and changed if severe infection occurs underneath. It shortens the period of treatment, and it is surprising how quickly the superficial burn has healed and the raw surfaces are available for skin grafting. If allowed to heal without grafting the scars are pliable and there is lesser tendency for contractures and keloid formation due to early removal of subjacent oedema.

While dealing with the burn of the extremities alone, specially that of the lower extremity, the same method and

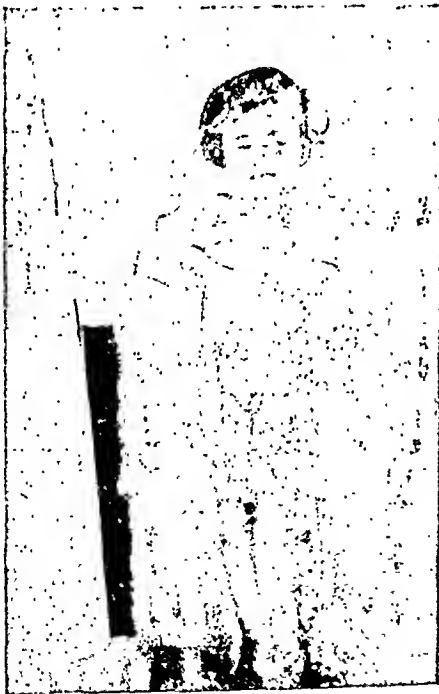


Fig. 4.

Shows the end result of closed plaster method of treatment for a highly infected deep burn of the left lower extremity.

principle is extended by using plaster of Paris in place of elastic bandages. The closed plaster method has given us very gratifying results in the treatment of infected burns of the extremity. The limbs are kept in the elevated position in the early part to avoid reactionary oedema. In the closed plaster method, the proteolytic action of pus is a valuable and important factor in the separating, dissolving and cleansing of sloughs. The dramatic results achieved in wound healing under closed plaster is now a well known and established fact. Repair of burns occurs in the same way as repair in wounds. There should be no hesitation in extending this very useful method to burn cases in increasing number. This method provides rest and comfort to the patient as well as to the medical attendant. Repair of the burn damage occurs under the best conditions, oedema and exudate are minimised, infection is controlled and reinfection is eliminated.

In fighting against infection, it is important to prevent further contamination of the burnt area; whatever organisms are already there should be starved by early and prompt removal of slough, attacked with sulpha drugs and penicillin and immunological processes in the patient should be bolstered by restoration and maintenance of physiological balance.

Infection, particularly with haemolytic strepto-coccus and to a lesser extent with staphylo-coccus leads to delayed healing with excessive production of granulation tissue and produces scarring and contractures. Anti-biotics and chemo-therapeutic agents, to some extent, by inhibiting the growth of organisms produce rapid healing, lessen fibrosis and, consequently, even if healing has to occur with scarring, the scar is soft and pliable with lesser tendency to contractures and greater ability to withstand the trauma of ordinary use. Neither sulpha drugs nor penicillin exert more than limited control over the growth of bacteria in a deep burn. Therefore stringent precautions against contamination of

burns is essential, and hence the necessity for and the value of prevention is as great today as in the pre-antibiotic and chemo-therapeutic era.

For many years the surgical profession has been struggling about the problem of early disposal of sloughs in deep burns.

Connor and Harvey obtained good results with the use of pyruvic acid starch paste. In a few cases of burns in which I had the opportunity of employing this method, I was impressed with the rapidity with which sloughs separated in deep burns, and their early disposal provides surface available for grafting in the short period of about two weeks. In this method which can be employed as a useful adjuvant to the pressure method of treatment, there is no damage done to the living tissue and heal-burns, I prefer to use penicillin in a cod factory.

7 c.c. of pyruvic acid is added to 1 litre of distilled water. 100 gram of corn starch is mixed with 200 c.c. of diluted acid solution which is gradually mixed with 800 c.c. of boiling acid solution. The bowl containing this paste is cooled in ice. Vaseline gauze is applied right round the burned area, paste is thickly applied over the burn and covered with many layers of vaseline gauze. This is essential to prevent drying of paste between dressings which are done about 2 to 3 times a week.

This acid debridement appears to be dependent on the maintenance of correct supply of hydrogenions over a sufficient period of time. Evidence is also available that the effects are not specific to pyruvic acid, and that phosphoric acid solution is as good if not better. Further, starch as a vehicle is being replaced for convenience by several others for example Cellulose Gell, jellies, etc.

The most recent advance in connection with the deep burn appears to be the practical application of surgical debridement of even extensive areas with immediate skin grafting. Unfortunately I did not have an



Fig. 5.

A case of a mixed burn where sloughs have been quickly separated in two weeks and the superficial burn is healing satisfactorily. (Pyruvic Acid Debridement)

opportunity of performing this in any of my cases.

The other methods are dealt with briefly:—

1. *Bunyan Envelope Method*: In this method the part to be treated, specially extremities, is enclosed in specially treated waterproof silk envelopes. Irrigation with electrolytic sodium hypochloride solution (Milton's solution) was originally used. Initial irrigation is done with 1 in 5 and subsequently with 1 in 20 thrice daily. Now saline irrigations are performed. Thorough drainage after irrigation is important. Envelopes are filled with warm air or oxygen in the intervals. The patient is encouraged to move his hands or limb and to use his fingers or toes, while in the envelope, from the very start. It is, therefore, that the patient does not lose confidence or become depressed. It has also the advantage of being painless, easily and quickly applicable and the process of repair can be watched through these envelopes.

2. *Saline Bath Method*: So popularly used by Dermatologists in Vienna for the treatment of severe burn cases requires

considerable nursing care, well-trained team of workers, and specially equipped burn centres.

During the last war, the low incidence of pain and shock among the burn casualties while in the salt water of the sea attracted attention to this mode of treatment.

The patient is given local or general warm saline bath as the case may be for one hour three times a day. Arrangements for the continuous flow of saline through the tub is useful. At each bath, the patient is thoroughly cleaned of all dead and necrotic tissues. In the interval tulle grass is applied over the burn, saline soaked compresses are applied and not permitted to dry by second hourly moistening and covered by some impervious material like oiled silk. This method is not advisable in the early stages of shock.

The above-mentioned two methods may be of some value in a few cases but cannot be recommended for all types of burn. Irrigation of abscess cavities, empyema, wounds and osteomyelitic cavities is being abandoned. They have, however, a useful place in the later stages of the treatment

when preparing the granulating surfaces for skin grafting.

3. *Tannic Acid Treatment*: Introduced in 1925 by Davidson, is not being practised today. While his method of treatment by tannic acid alone or in combination with silver nitrate and other substances is now dead, the great influence on the problem of burns, the awakening interest in the various aspects of burn therapy created by him will always remain alive.

Tannic acid which in the past was considered a safe and suitable coagulating agent has now been proved to be a toxic substance

proportionate to the amount of tannic acid used. Experimental and clinical observations conclusively prove the great damage tannic acid causes to the liver. Tannic acid considerably retards healing, it causes unnecessary destruction of viable tissue. It does not stop the exudation that continues beneath the coagulum during the burn shock. There is also absorption of tannic acid from the deep surface of the eschar that constantly undergoes liquefaction—this process is accelerated if sepsis establishes itself. Sepsis under the eschar is difficult to control. Healing under the tan is slower and separation of slough takes longer.

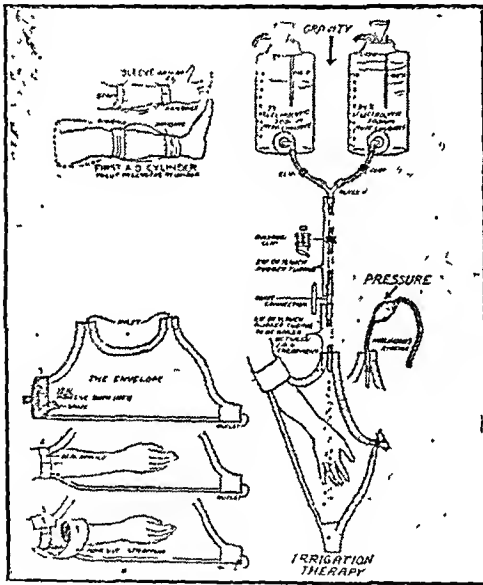


Fig. 6.

Use of Bunyan envelopes—method of application and irrigation (from Military Surgical Manual V). Envelopes applied (from Medical Annual 1943).

itself. There is post-mortem evidence of liver necrosis in 60 per cent of fatal cases after tanning. No necrosis was observed in the remaining cases, where tannic acid was not used. However it cannot be lost sight of that in untanned cases, death occurred within 24 hours while in those treated with tanning, it occurred between the 3rd and 7th day. Experimentally, in rats, the degree of hepatic damage was found to be directly

Tannic acid when applied in concentrated form may penetrate before superficial coagulation and produce deep caustic effect (Schentz). Through the crack in and around the eschar if not sealed from time to time, by sulphanamide powder or gentian violet, infection is liable to occur. Further this method is unsuitable for the face on account of its splinting action, and on the

fingers its constricting effect may imperil vascular supply and lead to gangrene.

4. *Aniline Dye Methods*: These were recommended for their antiseptic value in preventing infection and also for the thin, light and pliable eschar that does not crack.

Aldrich suggested treatment by 1 per cent gentian violet second hourly spraying for the first 24 hours and 4 to 6 hourly as required later.

Turner claimed good results with 2 per cent mercurochrome. This, he claimed, had the advantage of being transparent and pus could be detected early.

Wakeley suggested tanning by triple dye.

5. *Occlusive Dressing Methods*: Among the occlusive dressing methods mention may be made of paraffine mixture (with vaseline, cod liver oil, sulphonamide, and with traces of camphor, menthol and eucalyptus oil) spray revived by Pendleton of U. S. Navy of what was extensively tried in the first world war. Paraffine wax mixture is sprayed without debridement. Wax film is melted away by special heat bulb cages before second spraying. During this procedure melting wax carries away with it dead and damaged tissues. Spraying is done daily. In minor burns this mixture can be conveniently applied with a shaving brush.

Pickrell, spraying sulphadiazine with triethanolamine, methyl cellulose, sorbitol, and acetone produced a pre-formed membrane for pressure dressing of burn cases with good results.

Covering the burn with coagulated plasma, serum, and other blood products have been used as physiological dressings.

Recently Chase of Detroit, Michigan, has suggested the new protein eschar technic with or without pressure dressing. He claimed that extract of Aorta in saline spray, or in the cream or ointment base with penicillin added will prevent the oozing of plasma like fluid from the injured surface which occurs when ordinary pressure

dressings are applied. Further this eschar is claimed to prevent air-borne infection which may occur when changing pressure dressings.

Considering the poor facilities available in most places in this country, barring a few exceptions, many of these methods are not quite practicable.

Irrespective of the site, extent and duration of burn, the simple non-adherent pressure dressing method, with some modifications to suit a particular case, can be universally adopted with good results. The loss of circulating fluid can be considerably reduced by the pressure dressing and is therefore a valuable step towards preventing and combating burn shock. Scarring is considerably less when this method is used because the firm elastic pressure prevents plasma loss and removes early what protein fluid has already extravasated in the tissues subjacent and around the burn, and in this way does not provide a favourable medium for the proliferation of fibroblasts. This method has the merit of simplicity and a high degree of success to its credit provided the surgical principles involved in its application are properly and faithfully attended to.

It is a well-known fact that infection of the burn wound is best treated by prevention. If it requires an operating theatre, why should there be no special burn rooms in our hospitals where every thing could be done to treat burn case under the same aseptic precautions as for an abdominal operation?

Among other infecting organisms that might get a foothold in the burn and are most difficult to eradicate are *B. pyocyaneus* and *B. proteus*. Occasionally *B. coli* gain entrance to the burns involving the areas near the anus. Neither penicillin nor sulpha drugs are of any value in eradicating the common pyocyaneus organisms.

Application of 1 per cent acetic acid, urea formic iodide, or painting the surface thrice daily with 5 per cent gentian violet

helps in removing these organisms, if used along with the saline soaked dressings.

The longer the burn surface is allowed to remain, the greater is the risk of further infection and contamination, hence the need for early skin grafting.

### *After Treatment*

Wakeley considers that a follow up is just as important in burns as in fractures, if anything is to be learnt about the best forms of treatment and their end results. In this connection the best I can do, is to



Fig. 7-a.

Fig. 7-a shows a girl who had extensive mixed burn depicted in diagram 2 according to Berkow's scale. Skin grafting was refused.

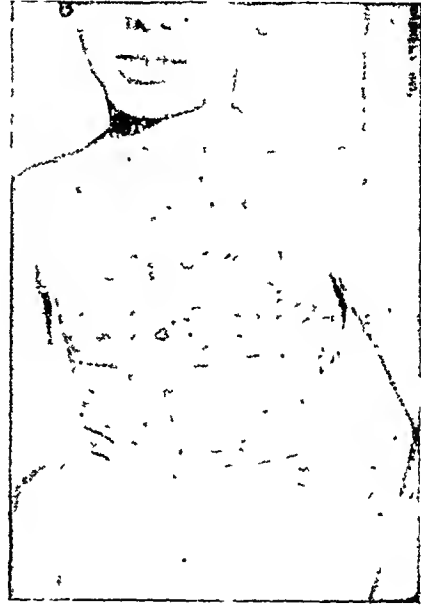


Fig. 7-b.

Fig. 7-b same girl some years after.



Fig. 7-c.

A good after-care with nightly rubbing of lanolin resulted in a good supple scar as shown in Fig. 7-c.

offer an apology, because neither have we an establishment for follow up, nor there is a response from the patients discharged from the Hospital. All the burn cases are advised to rub in lanolin every night, as soon as the burn has healed. This simple procedure helps to improve blood supply and lymphatic drainage of the burn scar, and keep it soft and pliable.

Figs. 7-a, b, & c shows a girl who was the victim of a mixed burn. She required skin grafting to prevent excessive scarring. However, in this case all persuasions failed and the deep burn was allowed to undergo natural process of repair by the formation of scar tissue, yet a very good after-care with nightly rubbing in of lanolin for a long period, has resulted in a good supple scar, able to withstand the tension and trauma of the active life of a school girl.

Superficial X-ray therapy is of value in the treatment as well as in the prevention of keloid scars. It is also useful in suppressing the excessive collagen formation that may occur between the sheets of skin in extensively grafted cases.

*(To be concluded.)*

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## ANAESTHETIC ACCIDENTS\*

by K. P. GANDHI.

Accidents occurring on the operation table in relatively healthy individuals are tragic happenings, enough to shake the nerves of seasoned and experienced surgeons and anaesthetists. In almost all such cases the disaster can be attributed to the improper handling of the patient before and during the operation by the anaesthetist.

Proper preoperative care will materially help to reduce the incidence of these accidents. It is imperative to find out gross deficiencies in any of the vital functions by a routine preoperative check-up. Proper preanaesthetic medication help to reduce the reflex irritability of the central nervous system and ensures an easy induction and maintenance of proper level of anaesthesia which necessarily varies during the different phases of the operation. The usual story is that every thing was going on well with the patient when a sudden deterioration occurred, which ended fatally inspite of all efforts at resuscitation. Trully speaking in a majority of cases it is not so. The theory of suddenness cannot be sustained when one reflects on the sequence of events, which led to the disaster. Proper selection of the anaesthetic agent and the technique of administration are all important. Due care should be taken to maintain an unobstructed airway by preventing the tongue falling back and by removing the mucus and other accumulations, if any from the throat; and attention should be paid to the proper plane of anaesthesia for the work going on, proper position on the table, adequate oxygenation, and avoidance of overdosage.

The writer does not wish to enter here into the details of prophylaxis and treatment of such tragedies on the operation table but wishes merely to record three cases which have left a long lasting impression on his mind. Of these three, the first two were cases of general inhalation anaes-

thesia, and the third one a case of intravenous Penthothal sodium.

The first case was of a fair looking healthy boy four years old, born in England of well-to-do parents. The patient was admitted into a public general hospital in May 1931, for removal of tonsils and adenoids. Atropine Sulph gr. 1/200 was ordered one hour before the operation. Patient was drowsy when put on the table. The anaesthesia was induced and maintained by open inhalation of Ether and Chloroform (4-1). A folded sheet was put under the shoulders, and a mouth gag was applied. The right tonsil was removed with a guillotine and a sponge on forceps was put into the fossa. At this time it was noticed that the patient was getting cyanosed and after two or three jerky respirations stopped breathing. The head was lowered, the sponge forceps removed, the pharynx mopped, a tongue clip was applied and artificial respiration and oxygen started. The pulse was good. Lobeline 1 c.c. was given subcutaneously. Two or three minutes passed away without any result and the patient's colour deteriorated further. His pupils were dilated. Adrenaline Hcl 1 c.c. was injected intramuscularly and the anal sphincter was dilated. After five minutes the patient's pulse became irregular and feeble. Out of desperation, artificial respiration was given at a faster rate and more forcibly. Another lobeline injection was given. At long last the patient took one inspiration, stopped for about ten seconds and then began to breathe again. In about two or three minutes, slow but, regular respirations started, cyanosis cleared away, pulse became regular and the patient was fairly out of anaesthesia. The left tonsil and adenoids were removed. The patient did not give any more trouble in the wards and was discharged next morning. On going to the wards and making inquiries, it was definitely ascertained that the child had

\*G. T. Hospital, Bombay.



been given one hour before the operation, half a tablet of a combined tablet morphine sulph gr.  $\frac{1}{4}$  and atropine sulph gr.  $\frac{1}{150}$  subcutaneously instead of atropine sulph gr.  $\frac{1}{200}$  as ordered. One is inclined to conclude that morphia gr.  $\frac{1}{4}$  had a good deal to do with the drowsy condition of the child and was responsible for the depression of the respiratory centre. A little chloroform in the mixture also might have contributed to some extent to the depression. The pulse was good for a fairly long time.

In children the respiratory system is very unstable. Besides the tracheobronchial tree in a child is very narrow. For these reasons morphia should be avoided in children under ten years for any operation, and more so, for operative procedures round about the airway. Throughout, children should be tactfully handled and the anaesthetic should not be forced upon them. Some sedative and amnesic drug should be given before the anaesthetic, otherwise, they might get some sort of a psychic trauma, which might be very harmful, if later on in life they have to undergo some other operative procedure.

This sedative and amnesic state can be easily ensured by barbiturates in one form or other, such as syrup of nembutal or a capsule of nembutal. Where a capsule is not practicable powdered nembutal may be administered with some honey or some tasty jam. Paraldehyde is also suitable for children particularly as it is not a respiratory depressant.

The second case was of a man aged fifty-five years, with right sided submaxillary cellulitis of a week's duration. The patient had difficulty in breathing for the two days preceding. There was sugar and albumin in the urine; B.P. 150/90. The patient's condition was very low and he was able to open his mouth to half the normal limit. The surgeon informed me a day before the operation that several consultations were going on regarding the case and if the patient should survive these consultations the operation would be undertaken.

The next day the patient was better. Morphine sulph gr.  $\frac{1}{4}$  and atropine sulph gr.  $\frac{1}{100}$  were given half an hour before the operation. Besides the surgeon his assistant and myself, a consulting surgeon and a physician were asked to stand by to look after the patient. The consulting surgeon asked me what anaesthetic I intended to use. I told him that I intended to give cyclopropane and oxygen. He advised me against a general anaesthetic, as he had a very bad experience in such cases, and had lost a case. The patient was made to lie down with a pillow under his head. He was not particularly dyspnoeic. As advised, I did not use general anaesthesia. The incision was made under local ethyl chloride, some pus was evacuated and the incision was explored by the finger. Naturally the patient did feel some pain. As the bandage was about to be applied, the operating surgeon asked the visiting surgeon whether he would like to verify the extent of the lesion. He put in his finger and began exploring. Patient was very uncomfortable and began to move his limbs. I put on an open mask and sprayed a little ethyl chloride. The patient after a little struggle held his breath and cyanosis began to appear. The jaw was in spasm, and could not be opened. Oxygen was run in through a nasal catheter and the head was lowered. 1 c.c. lobeline was given subcutaneously. The pulse was good. Corneal reflex was absent and pupils were dilated. Artificial respiration and 1.7 c.c. of Coramine were given and anal sphincter was dilated. By now the patient's mouth could be opened and an attempt was made to pass an endotracheal catheter with the head low. I could not identify the structures. Very often in these cases there is oedema and distortion of the pharynx and larynx. The pulse was getting weaker and coramine was again injected intracardially. It was now over six minutes. Though the heart was beating for over five minutes, all routine measures failed to start respiration and the patient expired.

It was a case of laryngospasm brought about as a result of the irritant effect of

ethyl chloride vapour on a larynx already narrowed and distorted due to oedema caused by neighbouring inflammation. An immediate stab tracheotomy might have saved the patient, at least for the time being. Whether operative interference in the region of the carotid sinus and carotid body contributed towards the disaster, it is difficult to say.

A few months after this incident, I came across an article, where the writer had one death and one narrow escape during anaesthesia for drainage of abscess of the sub-mandibular space. Thereafter in his next four cases he successfully adopted the following technique:—

10% aqueous solution of Cocaine HCl is sprayed in the nose and pharynx. After fifteen minutes Magill's endotracheal catheter is passed under direct vision with a thin bladed laryngoscope. An analgesic ointment\* is applied to the tip of the catheter to facilitate its longer retention if necessary. Blind intubation does not succeed due to oedema and swelling round about the pharynx and larynx. The gas machine is connected to the endotracheal tube and gas oxygen and if necessary a little ether is given, using a semiclosed system. In this way the surgeon is able to deal with the lesion with deliberation and hence able to prevent further extension of the disease. After the operation an oxygen mask of the B-L-B type is fixed over the catheter and oxygen administered in the wards continuously if necessary. If it is advisable, the tube can be kept safely for over a day. The next day, if necessary, the gas machine can be attached and dressings changed under gas oxygen analgesia, since the analgesic ointment applied to the tube favours its retention without discomfort.

This appears to be an elaborate procedure for an incision of an abscess, but it is the safest course to adopt, if the patient is to be operated under general anaesthesia. The

surgeon can deal with the lesion more deliberately than when local ethyl chloride is used.

The third case was of a boy A.S. aged 12½ years with bilateral ankylosis of the temporo-mandibular joints as a result of a fall on the head three years before. The operation proposed was excision of the condyles in two separate stages. The general health was fairly good. Since the fall, he had been unable to open his mouth completely. The maximum interval that could be obtained between the opposite rows of teeth, was about half a centimetre. B.P. was 110/70. There were no other abnormal findings.

The proper selection of the anaesthetic agent and technique was important, because the ankylosis led to difficulty in the maintenance of an airway. Endotracheal anaesthesia appeared to be the best under the circumstances but there was no space to introduce the laryngoscopic blade and direct vision introduction was out of the question. I was not quite sure whether I could do a blind naso-tracheal intubation. If the blind attempts were not successful, it was possible that some oozing from the nose and throat or some mucous secretions might gravitate towards the larynx, setting up a varying degree of laryngospasm right from the start and thus interfering with proper oxygenation of the patient. That is why, it was not attempted and in the end it was decided to give Penthothal Sodium intravenously.

On 11-10-1946, at 8-30 a.m. Atropine Sulph gr. 1/100 was given, half an hour before operation. The operation was on the right temporo-mandibular joint and so the head and face were turned towards the left side. Patient was in the recumbent position. 3¼% solution of Penthothal was started intravenously. During the course of the operation, the mandible was elevated by fingers passed under sterile drapes. Patient was having a fine stream of oxygen through the nose. The operation was over

\*1 per cent DIOTHANE ointment with oxyquinoline benzoate. (MERRELL)

in fifty minutes without the slightest incident. Patient had in all 1.2 gm. of Penthothal. 50 c.c. of 25% glucose solution was given through the same needle and the patient was sent to his room. Within half an hour, he began to move his limbs and then made rapid recovery.

At 9-00 a.m. on 17-10-46, the left side was taken up. B.P., premedication, and the position were the same as on the previous occasion, with the patient's head and face turned on the right side. 33% Penthothal Sodium was started intravenously and oxygen intranasally. After about 30 minutes he showed cyanosis which cleared up in a couple of minutes by pulling out the tongue and increasing the oxygen flow. The operation was over in about the same time as on the previous occasion with approximately 1.2 gm. of Penthothal. 100 c.c. of 25% glucose was started intravenously through the same needle. In the meantime the head was turned from the right side and kept straight in the middle line to inspect and remove sutures from the right side which was operated on the previous week. While these things were done, it was noticed that the patient was not breathing and was cyanosed. The head was lowered, tongue pulled out, artificial respiration and coramine 1.7 c.c. given. Patient started breathing again in half a minute and continued to breathe in a depressed way. Dressings were applied and patient was shifted to his room with the mouth gag and tongue clip on. The foot of the bed was raised and oxygen continued. At 10-15 a.m. B.P. was 80/55; pulse 130 and respiration 16. From now onwards mucous secretion appeared in the throat and suction was kept up intermittently. Pupils were not dilated and there was no corneal reflex. 5% glucose saline was going on intravenously. Another 1.7 c.c. of coramine was given intravenously.

Patient's colour further deteriorated, breathing became irregular, slow and laboured and he continued to secrete a lot of mucous, which was being sucked away. At about twelve o'clock endotracheal catheter was passed blindly. Between 11

a.m. and 12 noon, many times his condition was very serious. At 12-15 p.m. B.P. was 110/80; P. 140; R. 16, and now as the patient was getting a rigor, saline was discontinued. After sometime plasma was started. In all 500 c.c. were given intravenously. Corneal reflex appeared. There were half hourly recordings, which showed B.P. going to 145/85 and pulse coming down to 126 with respiration 20 per minute. At 2 p.m. he began to move his limbs. At 3 p.m. he woke up and became extremely restless and complained of intense thirst. Water was given. After 3 p.m. the patient appeared safe and passed urine. The patient had temperature during the first 36 hours the maximum going to 102°F. After this period it settled down to normal and there were no post-operative or any other complications. Patient went home on 22-10-46.

1.2 gm. Penthothal proved to be more than what the patient could tolerate. In short, it was an overdose. Before the operation, it had been decided to keep the patient properly under anaesthesia and not to allow him to come out of the anaesthesia at any stage during the operation, for fear of nausea, cough, sneezing or such other disturbances. Penthothal is a vagotonic drug and an adequate dose is required to do away with these reflexes. Sometimes they are excited by trauma on sensitive parts, when the patient is in a lighter plane of anaesthesia. As the operation was on the face, it would have been difficult to attend adequately to these disturbances without encroaching on the operative field.

When the glucose was being given and the patient's head was in the middle line, the airway was neglected for a couple of minutes; the jaw having become mobilised, allowed the tongue to fall back easily, and brought about cessation of respiration. With prolonged administration of Penthothal, it is very advisable to keep a good watch on the patient's airway for some time after the operation till the reflexes re-appear.

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## Introduction

The subject of the arches of the foot present and has presented considerable points of controversy. The text books of Anatomy usually omit to mention these controversial features, speak of the arches as a series of static structures and are content with describing what they call their usual and standard forms and types. As the anatomical writers draw their inspiration from dead subjects, their description of the arches of the foot are designed to conform to limited standards and suffer from the discrepancy of having to deal with a static structure as against a dynamic one which the human foot essentially is. The usual anatomical description is that there are four arches in the foot.

- (1) Medial longitudinal arch.
- (2) Lateral longitudinal arch.
- (3) Posterior transverse arch.
- (4) Anterior transverse arch.

The medial arch is made up by the calcaneus, astragalus, navicular, the three cuneiforms and the 1st, 2nd and 3rd metatarsal bones. Its summit is at the superior articular surface of the astragalus and its two extremities or piers on which it rests in standing are the tuberosity of the calcaneus posteriorly and the heads of the 1st, 2nd and 3rd metatarsals anteriorly. The lateral arch is composed of the calcaneus, cuboid, and the 4th and 5th metatarsal bones. Its summit is at the talo-calcaneal articulation.

The posterior transverse arch is a half dome and if the two feet are placed side by side, the complete arch extends from the base of one to that of the opposite 5th. The anterior transverse arch is a complete arch and extends from the head of the 1st metatarsal to the head of the 5th metatarsal bone.

Anatomical text books again make no distinction between the factors which are

supposed to be responsible for the maintenance of the arches. According to Gray<sup>34</sup>—"the chief characteristic of the longitudinal arch is its elasticity due to its height and to the number of joints between its component parts. Its weakest part is the joint between the talus and the navicular bone and this is braced by the plantar calcaneo-navicular ligament which is elastic and is thus able quickly to restore the arch when the disturbing force is removed. This ligament is strengthened medially by blending with the deltoid ligament and is supported inferiorly by the tendons of the tibialis posterior, the flexor digitorum longus and the flexor hallucis longus. The arch is further supported by the plantar aponeurosis, by the small muscles of the sole of the foot, by the tendon of the tibialis anterior and by ligaments of the articulations involved. The lateral arch is supported by the long plantar and the plantar calcaneo-cuboid ligaments, the tendon of the peroneus longus and the short muscles of the little toe".

Fraser<sup>30</sup> likens the arches of the foot to stone arches composed of several segments and says that like the latter they can be secured in three ways.

- (1) Inter-segmental ties.
- (2) Ties between the pillars.
- (3) Strap under the highest part of the arch.

For the medial longitudinal arch the inter-segmental ties are represented by the ligaments connecting the articulating bones—the ties between the pillars are provided by the muscles and fasciae extending between the tuberosity of the os calcis and the great toe along the inner side of the foot and the strap under the arch is the expansion from the tendon of the tibialis posterior to the cuboid passing under the head of the astragalus. Similar methods of anchorage apply to the lateral and transverse arches.

In Buchanan's anatomy<sup>12</sup> the longitudinal arch is described as before as being composed of medial and lateral segments but the transverse arch is present only at the

\*A thesis submitted for the MS Degree of Calcutta University.

distal end of the tarsus and the proximal end of the metatarsus and there is no mention of arching at the heads of the metatarsal bones. The longitudinal arch is also mentioned as being supported by the plantar calcaneo-navicular ligament, the tendons of long flexor muscles, by the flexor digitorum brevis, by the long plantar ligament and by the plantar aponeurosis which plays the part of a string to a bow and prevents undue separation of the two pillars.

In Cunningham's Anatomy<sup>19</sup> the opinion is expressed that the most important factors responsible for the prevention of excessive flattening of the arch lie in the plantar concavity; they are the plantar calcaneo-navicular, the long plantar ligament, and the plantar calcaneocuboid ligament. The various slips of the tendon of the tibialis posterior, as they pass to find attachment to the different tarsal and metatarsal bones give additional support. The plantar aponeurosis is also an important factor, for as it extends between the two pillars and is attached to both, it operates in the same manner as the "tie beam" of a roof.

Callender in his text book of Surgical Anatomy describes a high medial longitudinal, low lateral longitudinal and a transverse arch which is relatively high and narrow in the middle of the foot where the wedge shaped middle and lateral cuneiforms are strong. The forward part of the arch is broad, flat and weak. It often gives way letting down one or more of the metatarsal heads beneath which painful callosities form. The maintenance of the arch he ascribes to the ligaments which are said to act only as passive agents, in contrast to the muscles, which take an active part and are indispensable for the maintenance of the proper shape of the arch. Because of the elasticity of the ligamentous apparatus, the arches flatten out when the foot has to sustain a heavy weight but regain their original shape immediately the weight is removed.

Quain's anatomy<sup>66</sup> says that the longitudinal arch when the foot rests on an even

surface is supported by two piers, a posterior formed by the tuberosity of the calcaneus and the anterior formed by the heads of the metatarsal bones which all lie practically in the same horizontal plane. The weight of the body is transmitted through the talus to the arch not at its highest point which lies in front of the bone but rather behind it and is conveyed to the posterior pier through the calcaneus. This bone which is tilted upwards in front is supported by five ribs which merge behind, diverge in front and individualise themselves in the five metatarsal bones which with the cuneiform bones and cuboid are bound together transversely in a transverse arch. The weight is distributed equally along the five ribs to the anterior pier of the arch and causes a certain amount of flattening of the transverse arch and spreading of the heads of the metatarsals. The longitudinal arch is supported by strong plantar ligaments especially the plantar calcaneo-navicular and calcaneo-cuboid. Of special importance according to Fick is the lateral part of the plantar calcaneo-navicular ligament. The ligaments are assisted by the strong plantar fascia and the tone of the muscles is also an important factor. The transverse arch is supported by the transverse plantar bands and the interosseous ligaments, while the crossing in the middle line of the foot of the tibialis posterior must also play a useful part to the same end.

Piersol's Human Anatomy<sup>64</sup> says that the arches depend very much for their stability on the action of the peroneus longus and the tibialis posterior which pull against each other from opposite sides. The former is efficient in maintaining the transverse arch, the latter in maintaining both the transverse and the antero-posterior. To these should be added the plantar fascia and the muscles to the toes arising from the calcaneum.

Morris's Human Anatomy (1925) edited by Jackson mentions the following factors as being responsible for the maintenance of the arch.

(1) Plantar fascia binding the pillars of the longitudinal arch.

(2) 'Plantar calcaneo-navicular ligaments.

(3) *Tibialis posticus*—of the numerous offsets of this muscle that to the navicular is the most important. By coming into action when the heel is raised, this tendon helps the calcaneo-navicular ligament to support the head of the talus and to maintain the arch of the foot when the weight of the body is thrown forward on to the instep. In other words, the *tibialis posterior* comes into play just when the heaviest of its duties is devolving upon this ligament, viz. when heel is being raised and the body weight is being thrown over the instep on to the opposite foot.

(4) Calcaneo-cuboid ligaments—long and short.

(5) *Peroneus longus*—this raises the lateral pillar and steadies the lateral side of the arch. Further by its strong process attached to the first metatarsal bone, it keeps the great toe strapped down firmly against the ground and thus keeping down the anterior pillar of the longitudinal arch, it aids the firmness of the head.

(6) *Tibialis anterior*—this braces up the key stone of the arch. Thus by keeping up the first cuneiform, it maintains the navicular and so indirectly the talus in situ.

It will be realised from this brief review of anatomical literature that the general anatomists make no distinctions between the ligaments, fasciae and muscles as such in their role of sustaining the arches especially the longitudinal arch. They are considered to be equally responsible and one is as important as the other.

It is when we come to consider the arches of the foot from the orthopaedic point of view that differences arise and among the writings of the orthopaedic surgeons marked and fundamental divergences as regards the nature, structure and the means of maintenance of the arches of the foot and the reasons for its lowering and flatness are

manifest. Some like Norman Lake would like to consider the arches especially the longitudinal arch as having been built on a structural basis and so depending for its security on bony configuration and ligamentous support; the muscles coming only as auxiliaries lending support by their contractural tonus especially in certain phases of locomotion when the whole strength falls on the anterior portion of the arch of the foot—the os calcis and the heel being off the ground. The opposite point of view is supported among others by Bankart, who considers the permanent rigid arching of the foot as a contractural deformity brought about by continual wearing of rigid shoes—the price of civilization. To them the normal foot is perfectly supple, capable of assuming an arched form and lowering it at will. The arching is the result of the postural tone of the “antigravity” muscles—the ligaments under normal circumstances bear no strain and the failure of the arch and the consequent foot strain occurs when the postural tone of the muscles gives way and the ligaments are made to bear the strain of the body weight. The points of controversy as regards the arches of the foot and especially the longitudinal arch between these two schools of thought may be summarised as follows.

(1) Is the longitudinal arch of the foot always present?

(2) Is the longitudinal arch of the human foot one of its structural features or is it a structural abnormality brought about by continual wearing of rigid shoes?

(3) On what does the longitudinal arch depend for its maintenance—whether on bony configuration, ligamentous support or muscle tone?

(4) What are the causes of the lowering of the arch and of foot strain?

The differences between the two schools of thought are fundamental. To one the rigidity and the arching of the adult human foot is perfectly normal, permanent and a static anatomical feature. “The evolu-

tionary destiny of the human foot is to the production of a rigid structure having an arched form but devoid of any movements other than those at the ankle and the toe joints. The adoption of the unyielding and limiting foot wear by man was functionally but an anticipation of a general evolutionary trend" (Lake).

The other school considers the permanent unalterable arching of the adult human foot as an abnormal phenomenon produced by the continual use of rigid foot wear. They also hold that the normal arch should be flexible and depend mainly for its maintenance on the postural tone of the muscles; the ligaments or the body configuration are of secondary and small importance.

The purpose of my thesis is to find out the truth between these divergent opinions. I have approached the problem from three directions.

- (1) From the clinical point of view.
- (2) From the embryological point of view.
- (3) From the evolutionary point of view.

The clinical portion of my work was done at the Sambhunath Pandit Hospital, where I have made free use of all the materials available. patients, nurses, doctors, menials, etc.

For the last part of my work I attended the Zoological and the Anthropological departments of the University of Calcutta. I also examined a specimen of the Zoological department of the Benares Hindu University. In the first two places I was allowed to make free use of the Museum specimens and the accompanying diagrams are all taken from these Museums.

For the embryological portion of my work I attended the department of anatomy of the Calcutta Medical College where a large collection of foetal feet was placed at my disposal. The sagittal sections of the small fetuses were made in the Pathological department of the same Institution.

The procedure of work that I have undertaken is not absolutely new. Some work from the embryological aspects on the same problem has been done by Bruce and Wahmsley in 1938 and reference is made to a similar procedure by Lake (1935). Much work on the evolutionary trend of the human foot has been done by Morton, Weidenrich, Keith, Davenport, and Wood jones. The clinical portion of my work is unorthodox and I have combined the evidences and the deductions obtained from each of these three different directions to arrive at a conclusion as regards the veracity of one or other of these two different opinions about the longitudinal arch of the foot that I have enumerated.

### Reviews of Literature

*A. Views of those favouring the idea of a permanent structural arch depending upon bony configuration and ligamentous support.*

Clarke (1921) examined 100 consecutive cases of flat foot and came to the conclusion that in the majority of the cases, the falling of the arch, is due to the abnormal configuration of the constituents of the tarsal bones. A similar opinion is also held by Novojssevand (1923) who held that bony displacements are a marked feature of the majority of cases of flat foot, especially changes in the direction and shape of the astragalus and fusion and obliteration of the calcaneo scaphoid joint. Calcaneo scaphoid fusion as a cause of flat foot is also mentioned by Seddon (1933), who says, that it is a congenital abnormality and occurs in 25% of cases.

Morton (1924) from the researches on the evolution of the human foot came to the conclusion that the longitudinal arch is a new and distinctively human creation produced as the result of his early terrestrial habits, erect posture and increase of body weight. The most important factor in the causation of this new creation is the development of the heel as the result of increased leverage effort. The anthropoid apes such as the gibbon, the chimpanzee, the orang and the gorilla, as will be seen



later on, do not show the presence of the same arching of the foot. They have retained their arboreal habits for a much longer period and have only recently become terrestrial. Therefore the longitudinal arch which is an expression of grace and economy of effort in terrestrial locomotion has not had time or the opportunity to become developed in them. Reference will be made to the same subject in a subsequent chapter.

In a subsequent contribution (1925) Morton, from his staticometer study, which is an instrument designed to detect the amount of strain in the different segments of the foot when bearing weight, concluded that the rigidity and the integrity of the arch did not depend on the muscles. He says that the ligaments are uniquely adapted for the continuous and prolonged strain of static stresses in stance. The brief and violent strain in the stresses of locomotion is counteracted by the contraction of the muscles as it is in accord with the known physiologic properties of muscles. In normal stance the function of the muscles is merely to balance the leg bones on the feet.

Dunn (1928) says that in the longitudinal arch, the stress of body weight is for the most part borne by the ligaments—the tendons and muscles being only accessories. The height of the arch is a non-entity in the reaction of the arch to stress.

Lagomarsino (1930) is of opinion that the arch of the foot is maintained by its peculiar bony structure and ligamentous support. When it is actively used, the arch is also partially supported by the muscles but when it bears the weight of the body in standing, the ligaments bear almost all the strain. The arches are thus slightly depressed because of the elasticity of the ligaments and fasciae.

Henderson (1933) called attention to the disagreement over the relative importance of the muscles and the ligaments in support of the arch and thought it probable that the ligaments are becoming of increasing importance.

Whitman says that when the foot serves as a passive support the ligaments bear the greater part of the strain and their normal elasticity allows the bearing surface to expand as the arches are slightly depressed. During active locomotion the ligaments are helped by the contractural force of the muscles.

Norman Lake (1935) is the most ardent supporter of the theory of a structural arch. According to him the chief factor in the production and maintenance of the arch is the conformation of the bones and the factor next in order of importance is the plantar ligaments of the foot. The plantar fasciae and the short muscles of the sole are subsidiary factors which also help. The calf muscles—ordinarily of no help,—by their contractural force in certain phases of locomotion, especially when the heel is off the ground, take some of the strain and thus are also of use.

Lake makes the following further observation—"The postural tone of the muscles is anti-gravity not in the sense that it is responsible for resisting the whole effect of the gravitation, but it regulates mobility of joints in the weight-supporting skeleton. For example, in the knee joint, the bones support the weight: the function of the postural tone of the quadriceps is to balance the femur on the tibia, so that the weight is transferred directly through the longitudinal axis. The application of this idea to the support of the arch of the foot is an unwarranted extension due to mis-conception. Here we are dealing with a question of dead weight and not with the delicate balance of one bone upon another. Ligaments are used for support of super-incumbent weight in joints where little mobility is possible, viz. sacroiliac joint. The function of the postural tone of the muscles is to balance the leg upon the foot."

Bruce and Walmsley (1938) examined the feet of a large collection of fetuses from the 40 mm., i.e., 10 weeks stage. Their conclusions were that by the end of the 3rd month of foetal life, the foot is already arched in a



manner closely resembling the arching of the normal adult foot. The modification which the bones undergo in the later part of foetal life and infancy and the changes which these modifications produce on the arches are imposed on a skeletal form which is primarily an arched one. They also opine that the apparent non-development of the arch in the foetus and the new-born is probably accounted for by the inverted position of the foot and the plantar pad of fat which is present here at this time and hides the arches.

Clifford James (1939) carried an investigation by obtaining the foot prints of 65 natives of Solomon Islands who do not wear shoes and compared them with those of 5 Europeans. Their conclusions were as follows:—The longitudinal arch exists in both European and native races and is a definite structural feature of the anatomy. Though it can be increased by muscular action, it cannot be flattened either voluntarily or passively even under an anaesthetic by manipulation with hands.

R. L. Jones (1941) made a detailed experimental study with the muscles of the foot especially the long leg muscles. His conclusion were as follows:—

(1) The posterior tibial and peroneus longus are relatively unimportant as plantar flexors bearing only 5% of the total tension stress.

(2) Of the total tension stress of the longitudinal arch, not more than 15 to 20% is borne by the deep posterior tibial and peroneal muscles. It is unlikely therefore that these muscles will be responsible for the maintenance of the arch.

(3) Much the greater part of the tension stress of the longitudinal arch is borne by the plantar ligaments of the foot. The short plantar muscles also contribute to the support of the arch.

(4) Distress or failure in the human longitudinal arch is correlated not with the absolute value of the stress on the arch but with the temporal duration of the stress.

(5) A fallen or flattened arch cannot be raised by muscular exercise.

(6) An important and perhaps the chief function of the so called invertor and evertor muscles is to preserve a relative constancy in the ratio of weight distribution among the metatarsals of the foot, compensating reflexly for intrinsic and extrinsic factors which alter that ratio.

It may be noted that this conception of the function of the invertor and evertor muscles is different from that of Morton (1935) who assigned to them the important function of balancing the leg upon the foot as a stable base.

*B. Views of those favouring the idea of a postural arch depending mainly upon the postural tone of the muscles.*

Lovett (1916) studied the feet of 800 nurses and came to the conclusion that the lowering of the arch was due to muscular strain.

Keppler (1917) says that the wasting and atrophy of the muscles is the cause of weakness of the foot with or without lowering of the arch. The most important cause of this atrophy of the muscles in civilized races, he says, is due to their being squeezed by rigid shoes. "It is also due to our unnatural walk with high heels, in which the toes are turned outwards and greatly increased strain is put under the innerside of the foot structure."

Crandon (1919) is of opinion that the weak, flat or pronated foot should be treated as a physiological and not as an anatomical entity. He says, "From the practical side of function and treatment, the human foot has no more a fixed arch than the extended hand until the muscles make one. Substitute the phrase "arching of the foot" for "arches of the foot" and the mental attitude towards the feet changes."

Cotton (1920) says that in cases of so called flat foot, there is no real deformity, merely a position of relaxation into pronation which may be corrected. This habitual pronation is due to weakness of the

muscles and must be treated along physiological lines. Changes in shoes and heels and insertion of pads will give comfort but a radical cure can only be obtained by the education and exercise of muscles.

Scheimberg (1920) says that the cause of weak feet in the child is reduction of postural tone and is associated with round shoulders, protruding abdomen, clumsiness in action and frequent falling. In the treatment, no operation is necessary nor plaster of Paris or adhesive plaster to hold the foot in supination. Successful treatment demands attention to attitude, foot gear and exercise.

Roberts (1920)—According to him the three common factors in the etiology of weak foot are, improperly designed foot, unequal development of leg muscles and deviation of the normal mechanical relations between the tarsus and the leg. He emphasizes the advantages of muscle training.

Fairweather (1926) in discussing the effects of continual use of high heeled shoes says that it is the muscles which pass under the plantar calcaneo-navicular ligament that are mainly responsible for the maintenance of the arch. The foot is considered as a weight-bearing tripod resting on the heel, first metatarso-phalangeal joint and the whole of the fifth metatarsal bone. When the heel is raised as in wearing high heel shoes, the strain falls more on the antero-internal tripod. Nature provides some compensation for the longitudinal arch as the muscles under the internal malleoli become straightened and can therefore pull with mechanical advantage but if one has to do long periods of standing in high heels or due to the effects of illness, the muscles get tired and atrophied and the ligaments and fascie being unable to sustain the arch, it begins to give way and foot strain occurs.

Rossmith (1928) thought it erroneous that the arches of the foot are supported by ligaments. In the foot, as elsewhere, the purpose of ligaments is to hold the articulating bones in apposition and to check momentarily excessive movement. Being

inelastic, the ligaments cannot withstand continuous strain under which they soon stretch. The maintenance of the arches when weight bearing depends normally on the long and short muscles of the foot. During standing the body weight tends to dorsiflex and pronate the feet. Accordingly those muscles which can resist dorsiflexion and balance the foot in mid-position between pronation and supination are found to be tonically contracted. They are triceps, the long leg muscles and the peronei. The long peroneus also supports the inner part by holding the great toe firmly against the ground. The lumbricals, the interossei, the abductor hallucis and the short muscles are also tonically contracted and help the arches.

Cyriax (1930) was of opinion that flat foot could only be corrected by strengthening the weakened muscles through a process of muscular re-education.

Anapol (1929) made the suggestion that the tibialis anterior is very important and when it fails, flat foot results.

Gottlieb (1932) called attention to the antagonism between the triceps surae muscle which he stated contributed to the flattening of the longitudinal arch and short plantar muscles which contributed to its retention.

Forester Brown (1932) says that the muscles which maintain the normal position of slight inversion in weight bearing are the tibialis posterior and anticus. If their functions are lost, no mechanical adjustments of the foot can restore the normal balance.

Keith (1933) from his study of the evolutionary history of foot muscles came to the conclusion that the muscles originally subserving prehension in pronograde animals take over a new function in stabilising the foot when applied to the ground and in producing and maintaining the arches of the feet. Nature, he says, never uses ligaments as prime supporters in the structure of the animal body. Always muscles are used for this purpose. Ligaments only act as safe-

guards, coming into action when muscular defence has broken down. In support of his contention that the main support of the longitudinal arch are the muscles, Keith recalls the fact that many muscles of the feet which in pronograde animals were subserving prehension find new attachments and alter their line of action to perform this new function of the maintenance of the arch to their best advantage. These muscles are :—

(1) The plantaris—in the pronograde animals is was prolonged into the sole but in man the growth of the "anthropomorphic" heel separates the tendon of the plantaris from its prolongation into the sole—the middle part of the plantar fascia, which assists in maintaining the arch.

(2) The flexor brevis digitorum which, in lower primates, arises principally from the long flexor tendons has its origin completely transferred to the os calcis in man and can thus act more powerfully in supporting the arch.

(3) The flexor accessorius—a detached part of the flexor longus hallucis is specially well developed in man and helps to maintain the arch.

(4) The tibialis posticus, originally a flexor of the metatarsus corresponding to the flexor carpi radialis of the hand, obtains a secondary attachment to the scaphoid in man.

(5) The tibialis anticus which corresponds to the extensor osis metacarpi pollicis of the hand becomes permanently inserted into the internal cuneiform. Both of these muscles help to maintain the arch of the foot.

Wiles (1934) says that the function of the ligaments is to check extremes of movements. They do not play any direct part in the maintenance of posture and no continuous strain falls on them. It is the muscles that hold the joints in position and only when they fail are the ligaments placed under strain. The posture of the foot including the height of the arch depends on

the position of the intrinsic joints. The body weight is transmitted from bone to bone just as it is from femur to tibia. The position of the joint is altered by active muscular contraction and maintained by the tone of the posturing muscles as it is every where else in the body. Further, in reply to one of Lake's articles in the *Lancet* (1937), Wiles adds that the normal foot is a moderately supple structure, permitting movement at the sub-astragaloid and astragaloscaphoid joints. These change the height of the arch which therefore depends on the position of the sub-astragaloid joints. Ligaments could only play an important part in the integrity of the arch if it was fixed in height like a masonry arch. If the arch can really be raised and lowered at will, which he thinks could be done, the ligaments cannot behave in such a way because they have not the necessary elasticity.

Bankart (1935) is the chief exponent of this theory. According to him the function of the ligaments is not to withstand continuous strain. This is always the function of the muscles. The correct attitude of the feet in standing is maintained by the postural tone of the long leg muscles and it is but a part of the general postural reflex which maintains the upright position of the body as a whole. The arch of the foot then is not a fixed or constant structure but it is an attitude produced and maintained by muscular action. When they relax the arch sinks. The natural foot should be so supple that it can be completely flattened or raised into the form of an arch at will. The permanent arch seen in the feet of civilised people is due to the restrictions put on it by foot wear. Foot strain occurs when due to some cause the postural tone of the muscles becomes diminished and the other soft tissues are made to withstand the strain of weight bearing. In reply to the findings of Bruce and Walmsley already referred to, that the arches of the foot are present even from early foetal stage, Bankart shifted his ground somewhat and made the suggestion that when a joint or series of joints has a wide range of normal movement, one would

expect its anatomy to be disposed about an intermediate position and not to be adopted to one of its extremes. The normal foot at rest and free from weight bearing falls naturally into a position in which there is a moderate longitudinal arch. It is the fixation of this arch and consequent inability of the foot to yield without encountering resistance and strain that was regarded as unnatural.

Lange (1935) thought that lowering of the arch and flatness of feet was the result atrophy of muscles by constant wearing of hard narrow shoes. These practises have resulted in familial constitutional weakness of the feet.

Kaplan & Kaplan (1935) from their study of the arches of the foot were of opinion that the long leg muscles played a major part in the support of the longitudinal arch. The muscles weakened by fatigue or other causes become unable to support body weight thus throwing an un-accustomed burden on ligaments, which give way and flat foot results.

Wiltz (1935) removed the muscles and exposed the tendons of the posterior tibial, flexor longus digitorum, peroneus longus, tibialis anterior and flexor longus hallucis. To each tendon he attached rubber bands which exerted pull of 5 lbs. tension. He then determined the load which when applied on the vertical tibia was necessary to depress the talo-navicular and calcaneocuboid joints. He then freed the respective muscle's tendon from the 5 lbs. tension and again determined the load necessary to depress the above mentioned joints. From data thus obtained he concluded that there were 2 means of support of the longitudinal arch—a direct upward pull as exhibited by the tibialis anterior and peroneus brevis and a lift from below as shown by the long plantar muscles which is increased by mechanical advantage of pulleys and tendons.

Mercer (1936) says that variations in the height of the arch are achieved by

alteration in the position of the talo-navicular joints induced by contraction and relaxation of the tibial muscles. The reason for flatness of the foot on weight bearing in the child is the non-development of the postural tone of the long muscles which is a late human development. In the foot of the orthograde primate animals, the tibial muscles are concerned only with active movements of locomotion and have no postural activity. Should they fail to develop, in man, the arches are flattened by weight bearing.

In favour of Bankart's contention that the rigid arches of the human foot are really contractural deformities produced by habitual use of foot wear is the evidence of Miltner (1937) in China, who examined a large number of bound feet. The Chinese women are accustomed to practice rigid restrictions on the growth of their feet by binding them with stiff cloth or other materials. This results in increase of the height of the arch, the os calcis becomes vertical—the metatarsals are flexed and the muscles and ligaments are shortened and atrophied.

Schawrtz & Heath (1937) by examination of a large number of feet deduced that the weight bearing axis of the leg is normally situated inside the weight bearing axis of the os calcis. There is therefore a natural tendency to pronation in normal feet which is counter-balanced not by ligaments but by the long muscles which latter are necessarily responsible for the maintenance of the arches.

Ernst & Fisher (1937) said that the foot is held in its normal plantigrade position by the supinators. Weakness of these supinators cause laxity of the tarso-metatarsal joints and flattening of the longitudinal arch.

Bettmann (1937) advocated the strengthening of the lifting muscles of the inner border and the transverse portion of the arch with the idea that if the foot muscles were of normal tone and functioned properly they would prevent the painful lowering of the arch.

Higgs (1937) agreed with Bankart that the normal arch is maintained by the muscles—that the ligaments are not designed to sustain weight. According to him also the normal human arch should be so supple that the arch can be raised or flattened at will.

Lambrinudi (1938) ascribes to the long muscles the important function of originating and maintaining the arches.

#### The effects of footwear on the longitudinal arch of the foot

During the course of my clinical investigations I examined the feet of about 400 people. The best method of obtaining a permanent record of the arch under the different circumstances was considered and it was decided to obtain foot prints for the purpose by making the persons stand on a square piece of paper and putting on his body weight evenly on both feet. In those cases in which the persons were unable to stand, the print was obtained by spreading the paper on a piece of flat hard wooden board and pressing this against his feet. At the same time the knees were bent to a right angle and the person was asked to press against the board with all the force he was capable of. In some cases he was assisted in doing so. In all cases printers ink was used to smear the sole of the feet. The prints so obtained are modelled after the feet examined and when they are compared in a large series of cases, their value is enhanced. At the same time the persons were questioned as regards any abnormality or complaint about their feet; structural abnormality if any was noted and the height of the arch was measured, when required, being the distance from the ground to the tuberosity of the navicular bone (Davenport).

For comparing these prints from the point of view of weakness of the feet and lowering of the arch two different measurements were taken wherever necessary. One is the foot print line described by Leebivings

(1933) Fig. I. This is a line which passes through the centre of the heel (A) and another point (B) which is at the centre of a line drawn at  $\frac{1}{4}$  the distance from the heel to the great toe.

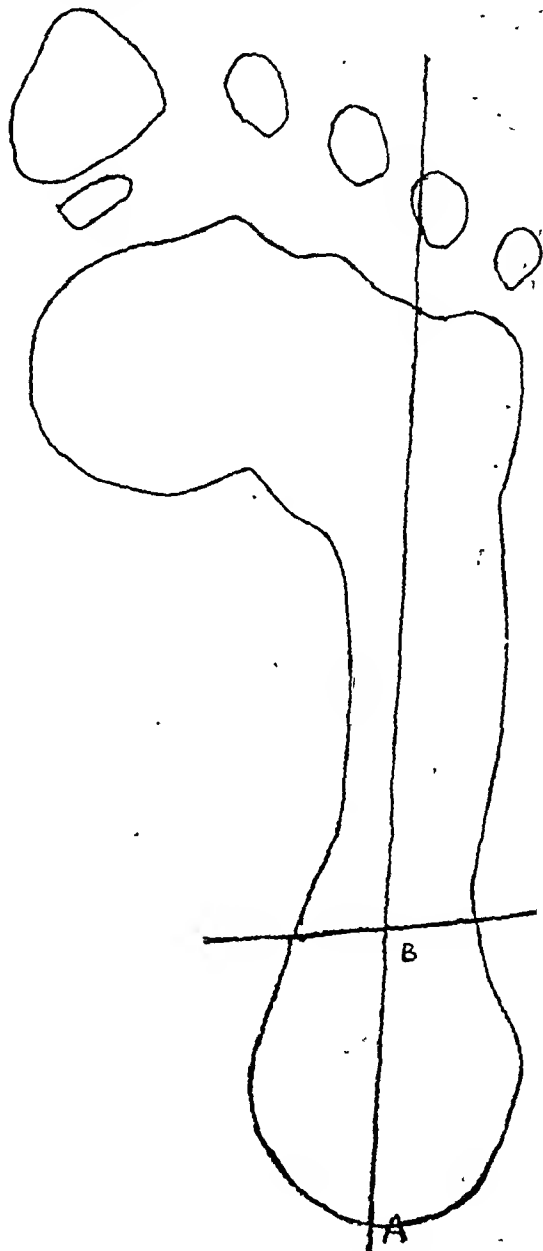


Fig. 1.  
Leebivings Foot-print Line.

This point is supposed to be at the junction of the astragalo-scapoid and calcaneocuboid joints and the fore part of the foot which is relatively mobile abducts from the posterior fixed portion at this junction. Th

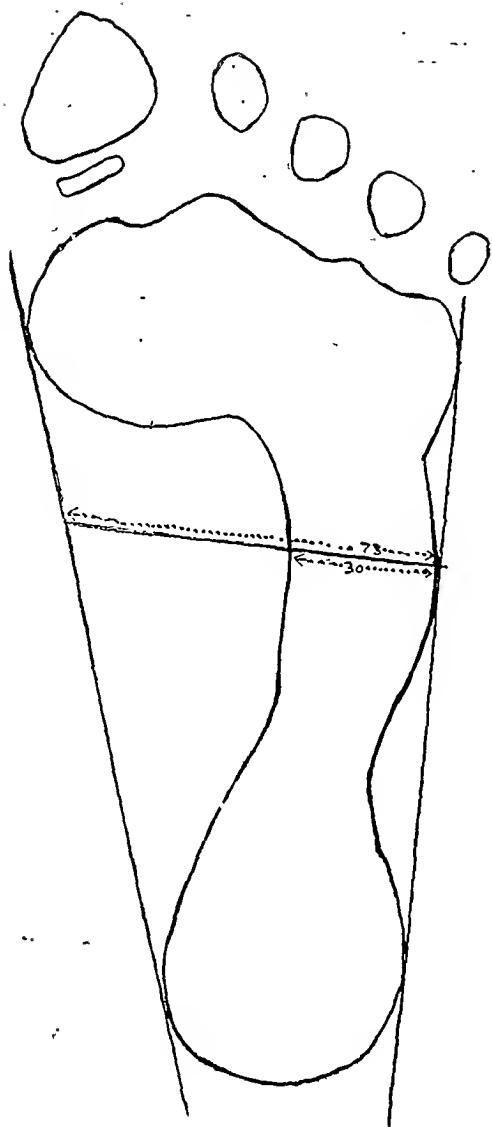


Fig. 2.  
Arch Fraction.

abduction of the forepart of the foot is usually associated with eversion of the foot and falling of the arch and is considered by Leebivings to be an indication of the weakness of the foot. This line prolonged forwards cuts one of the toes or passes between two adjacent toes. According to Leebivings, in a normal foot; it should cut the fifth toe or pass just outside it. In the first degree

of weakness of the foot, the line passes from between the middle of the fifth to the middle of the fourth toe. In the second degree of weakness the line passes from between the middle of the fourth to the middle of the third toe. In the third degree of weakness it is between the middle of the third to the middle of the second toe and in the fourth degree of weakness, which corresponds to a completely flattened foot, it is inside the middle of the second toe. The more abduction of the foot there is, the more the line passes inwards and the more weak the foot is supposed to be. (Fig. 1).

Another transverse line is drawn through a point at the middle of the distance between the heel and the great toe. The portion of this line included between the two lines joining the two sides of the heel and the balls of the great and little toes is arbitrarily taken to be the average breadth of the foot. The area of the foot print that comes in contact with this line is determined by the height of the longitudinal arch. The higher the arch the less would be the area that would come in contact with this line, and the lower the arch the more would be the area that would touch this line. Therefore the fraction of the area of the foot that touches this line to the average breadth of the foot as determined before, is an approximate indication of the height of the arch. This was determined in each instance and will subsequently be called the arch fraction of the foot. (Fig. 2.)

In order to determine the difference if any as regards the longitudinal arch between habitually bare-footed people and those who use rigid foot wear all the time I made a series of investigations. Fifty prints were obtained of those people who have never worn shoes and therefore have allowed their feet natural development (Table I). Twenty seven were menial servants of the hospital and 13 were odd people who did all sorts of work, labourers, handcart pullers, mechanics, etc. Of these 42 prints were photographed (Fig. 3). These are the people, in whom according to

TABLE I  
BARE-FOOTED PEOPLE

Name	Age	Occupation	Arch Fraction		Degree of Weakness	
1. Paramananda	20	Coolie S.N.P.H.	Rt = .80	Lt = .36	Rt = 2D	Lt = 2D
2. Jilmil	60	Methar "	Rt = .51	Lt = .54	Rt = 2D	Lt = 1D
3. Sk. Kunai	40	" "	Rt = .41	Lt = .46	Rt = 1D	Lt = 1D
4. Jangal	35	Coolie "	Rt = .50	Lt = .52	Rt = 2D	Lt = 1D
5. Bhuran	30	Methar "	Rt = .44	Lt = .47	Rt = 2D	Lt = 2D
6. Hansa Raj	17	" "	Rt = .33	Lt = .48	Rt = 2D	Lt = 2D
7. Chandradeo	28	Durwan "	Rt = .30	Lt = .29	Rt = 2D	Lt = 2D
8. Musraff Husan	21	Coolie "	Rt = .41	Lt = .43	Rt = 2D	Lt = 3D
9. Askrit Ram	30	" "	Rt = .43	Lt = .46	Rt = 3D	Lt = 2D
10. Babar	40	Methar "	Rt = .36	Lt = .38	Rt = 2D	Lt = 2D
11. Jagur Husan	32	Coolie "	Rt = .46	Lt = .51	Rt = 2D	Lt = 1D
12. Musali Ram	29	" "	Rt = .37	Lt = .35	Rt = 2D	Lt = 2D
13. Ram Kamal	35	" "	Rt = .29	Lt = .35	Rt = 2D	Lt = 3D
14. Nimula	25	" "	Rt = .37	Lt = .33	Rt = 1D	Lt = 1D
15. Kalkchand	25	" "	Rt = .30	Lt = .26	Rt = 2D	Lt = 2D
16. Kudan	22	" "	Rt = .35	Lt = .37	Rt = 1D	Lt = 2D
17. Kunai	26	" "	Rt = .20	Lt = .30	Rt = 1D	Lt = 2D
18. Rambilas	28	" "	Rt = .46	Lt = .45	Rt = 2D	Lt = 1D
19. Matilal	17	" "	Rt = .40	Lt = .41	Rt = 2D	Lt = 1D
20. Sajiban	60	" "	Rt = .25	Lt = .12	Rt = Normal	Lt = Normal
21. Raksit	29	" "	Rt = .40	Lt = .32	Rt = 2D	Lt = 2D
22. Prasanna	21	War technician	Rt = .37	Lt = .42	Rt = 2D	Lt = 3D
23. Mahammad	55	Cook	Rt = .40	Lt = .32	Rt = 2D	Lt = 3D
24. Basan	36	Coolie S.N.P.H.	Rt = .53	Lt = .45	Rt = 2D	Lt = 3D
25. Dokhi	27	Methar "	Rt = .35	Lt = .37	Rt = 1D	Lt = 1D
26. Sk. Bagal	35	" "	Rt = .30	Lt = .30	Rt = 2D	Lt = 2D
27. Samaru	40	Coolie "	Rt = .41	Lt = .37	Rt = 2D	Lt = 3D
28. Makbul	30	Labourer	Rt = .37	Lt = .41	Rt = 2D	Lt = 2D
29. Rambarat Ram	50	Sardar S.N.P.H.	Rt = .37	Lt = .36	Rt = 2D	Lt = Normal
30. Sk. Amir	16	Coolie "	Rt = .45	Lt = .45	Rt = 1D	Lt = 2D
31. Manmatha Das	31	Mechanic	Rt = .14	Lt = .40	Rt = 1D	Lt = 2D
32. Ismail	20	Methar "	Rt = .47	Lt = .50	Rt = 1D	Lt = Normal
33. Rambilas	40	Coolie "	Rt = .37	Lt = .42	Rt = 1D	Lt = 2D
34. Santa Lal	40	" "	Rt = .69	Lt = .66	Rt = 3D	Lt = 3D
35. Kali Charan	19	Dome "	Rt = .32	Lt = .21	Rt = 2D	Lt = 2D
36. Bhorai	22	Electric Mistry	Rt = 1	Lt = 1	Rt = 4D	Lt = 4D
37. Ramrup	25	Labourer	Rt = .31	Lt = .29	Rt = Normal	Lt = Normal
38. Jyoti Lal	20	Handcart Puller	Rt = .42	Lt = .36	Rt = 2D	Lt = 2D
39. Tangai	30	Labourer	Rt = .38	Lt = .42	Rt = 2D	Lt = 2D
40. Akbar Ali	40	" "	Rt = .36	Lt = .43	Rt = 1D	Lt = 2D
41. Ghura Ram	42	Coolie S.N.P.H.	Rt = .55	Lt = .63	Rt = 2D	Lt = 2D
42. Bangali Ram	30	" "	Rt = .67	Lt = .67	Rt = 1D	Lt = 1D
43. Durjan	36	" "	Rt = .72	Lt = .46	Rt = 3D	Lt = 2D
44. Sakur	40	Methar "	Rt = .54	Lt = .47	Rt = 3D	Lt = 3D
45. Chandradip	54	Coolie "	Rt = .51	Lt = .55	Rt = 1D	Lt = 1D
46. Ramu Ram	32	" "	Rt = .46	Lt = .58	Rt = 2D	Lt = 2D
47. Md. Razak	23	Methar "	Rt = .77	Lt = .89	Rt = 2D	Lt = 2D
48. Kaloo	35	Coolie "	Rt = .75	Lt = .45	Rt = 3D	Lt = 3D
49. Mamtaz	25	" "	Rt = .39	Lt = .38	Rt = 1D	Lt = 1D
50. Bhupati	45	Labourer	Rt = .40	Lt = .34	Rt = 2D	Lt = 2D

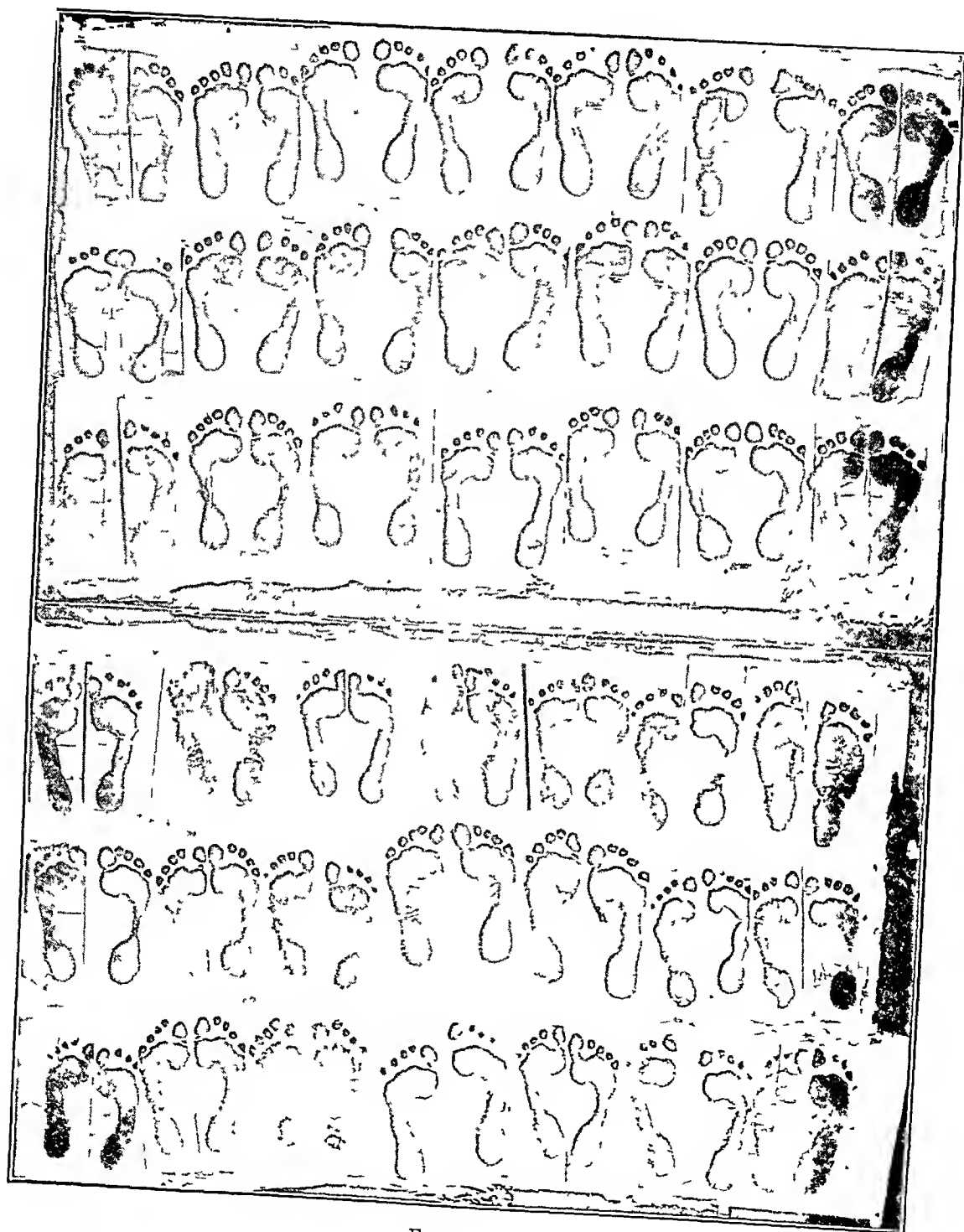


Fig 3  
Foot-prints of bare-footed people



Bankart, Wiles, Higgs and others, the arch should have been so supple, as to be capable of being raised and flattened at will. Let us quote Bankart's exact words. "The truth is that the natural feet as seen in the bare-foot races, who have never worn boots or shoes is completely flat, when the muscles are relaxed and are arched only when the muscles are in action. You may observe the same thing in the feet of ballet dancers—their feet are completely flat, when standing at ease and are highly arched, when the muscles are in action. You may observe the same thing in the feet of your own children when they are beginning to walk."

My observations were entirely contrary to the above statement. I found that these bare-footed people had well developed arches which were fixed structures and not capable of being altered at will except for the very slight lowering that took place when standing with the full body weight on the feet. The feet were far from supple, they were rigid and in-elastic and there was little or no difference between such feet and of those who habitually wear shoes, as far as the rigidity was concerned. The rigidity of the adult human foot and its fixed arch is not therefore the result of the use of foot wear but is due to some other cause. The same opinion is held by Clifford James (1939) who carried out an investigation amongst the natives of the Solomon Islands. His conclusion is that the longitudinal arch exists in the feet of both European and Native races and is a definite part of the anatomy. Though it can be increased by muscular action it cannot be flattened either voluntarily or passively even under an anaesthetic by manipulation with hands. He administered an anaesthetic to a normal native selected only because of his willingness to co-operate. When he was deeply under, a print was taken of his flaccid feet; pressure being applied with all the force that could be exerted. Comparison of the print of his flaccid feet with those of his feet under normal circumstances revealed no difference. The same conclusion was arrived

at by Thompson (quoted by Lake) after examining the prints of the natives in the African Tropical Zones. He noted well developed arches among some of the tribes and amongst others the arches were low and therefore the differences were not the results of restrictions of foot wear but were racial. Among the foot-prints of these 50 bare-footed people in my series there was one (Bhorai No. 36, No. 28, Fig. III) who had congenital flat feet. He acknowledged to having this flatness from his childhood, had no pain or complaints about his feet and was a hardworking individual being the electric mistry of the hospital. As his case belongs to a different category, he will not be considered in making the calculations and deductions. The rest of the 99 feet had well developed arches and the foot print line in the majority of the cases passed between the 5th, 4th or 3rd toes—that is, the 1st and 2nd degree of weakness of the feet were the commonest. The most prominent arch was in the left foot of No. 20 where the arch fraction was .125 (No. 8—Fig. 3) whereas the lowest arch was in the right foot of number 1, where the fraction was .80 (No. 23—Fig. 3). The average arch fraction of these cases was .374. Following Leebivings classification:—

"Normal" feet were seen in	..	6.2%
1st degree of weakness was seen in	..	28.7%
2nd degree of weakness	"	53.7%
3rd degree of weakness	"	10.2%
4th degree of weakness	" "	Nil. 0

It will be seen that according to Leebivings standard the greatest number of "natural" feet fall under the category of the second degree of weakness and the percentage of so-called normal feet is only 6. It will be unjustified therefore to stick rigidly to this classification and regard all feet whose foot-print line passes inside the little toe as abnormal since it does so in more than 50% of apparently normal cases. We might say therefore that all feet whose foot print line passes outside the middle of the 3rd toe are within normal limits and the real weakness of the foot begins when the line is deflected still more medially.

TABLE II

Name	Age	Occupation	Arch Fraction		Degree of Weakness	
1. Gadadhar Das	21	Male Nurse, S.N.P.H.	Rt = .51	Lt = .46	Rt = 1D	Lt = 2D
2. S. Chakravarty	26	" "	Rt = .39	Lt = .60	Rt = Normal	Lt = Normal
3. S. N. Chatterji	24	" "	Rt = .48	Lt = .34	Rt = 4D	Lt = 4D
4. P. C. Chatterji	26	" "	Rt = .86	Lt = .49	Rt = 3D	Lt = 3D
5. Md. Ali	24	" "	Rt = .49	Lt = .40	Rt = 3D	Lt = 3D
6. Dr. Guha	26	H.S.	Rt = .74	Lt = .62	Rt = 3D	Lt = 3D
7. Dr. D. N. Sen	57	Pathologist	Rt = .42	Lt = .43	Rt = 3D	Lt = 3D
8. Dr. Mitra	27	H.S.	Rt = .46	Lt = .46	Rt = 1D	Lt = 2D
9. Dr. R. Das	32	H.S. Seva Sadan	Rt = .48	Lt = .57	Rt = 2D	Lt = 2D
10. Dr. G. C. Chakravarty	28	H.S. S.N.P.H.	Rt = .35	Lt = .42	Rt = 1D	Lt = 1D
11. Dr. D. N. Ghosh	27	H.S.	Rt = .45	Lt = .46	Rt = 1D	Lt = 2D
12. Dr. S. N. Chatterjee	26	H.S.	Rt = .83	Lt = .83	Rt = 2D	Lt = 2D
13. Dr. R. N. Chatterjee	35	H.S. Seva Sadan	Rt = .42	Lt = .34	Rt = 2D	Lt = 3D
14. Dr. A. Das	26	H.S. Car. M. C. Hosp.	Rt = .51	Lt = .41	Rt = 2D	Lt = 3D
15. Dr. G. Ghosh	26	H.S.	Rt = .33	Lt = .33	Rt = 2D	Lt = 2D
16. Dr. Kumar	32	H.S. S.N.P.H.	Rt = .75	Lt = .74	Rt = 1D	Lt = 2D
17. Sakali Sarma	22	Compounder S.N.P.H.	Rt = .95	Lt = .47	Rt = 4D	Lt = 3D
18. Dr. Chanda	27	H.S. S.N.P.H.	Rt = .47	Lt = .48	Rt = 2D	Lt = 2D
19. Dr. Maitra	35	H.S. Car. M. C. Hosp.	Rt = .88	Lt = .95	Rt = 3D	Lt = 1D
20. Dr. B. Mukherji	37	H.S. S.N.P.H.	Rt = .88	Lt = .95	Rt = 3D	Lt = 3D
21. Dr. L. M. Sen	55	Anaesthetist, S.N.P.H.	Rt = .50	Lt = .56	Rt = 1D	Lt = 2D
22. Dr. D. Chatterji	28	H.S. Car. M. C. Hosp.	Rt = .36	Lt = .37	Rt = 3D	Lt = 1D
23. Dr. Neogy	32	H.S.	Rt = .46	Lt = .42	Rt = 2D	Lt = 3D
24. Dr. Ganguly	25	H.S. Seva Sadan	Rt = .94	Lt = .49	Rt = 4D	Lt = 3D
25. Dr. Ghosh	26	H.S. S.N.P.H.	Rt = .91	Lt = .94	Rt = 4D	Lt = 4D
26. Dr. M. Samanta	25	H.S. Car. M. C. Hosp.	Rt = .46	Lt = .45	Rt = 2D	Lt = 2D
27. Dr. A. N. Maitra	29	H.S.	Rt = .44	Lt = .32	Rt = 1D	Lt = 1D
28. Dr. Guin	29	H.S. P.G.H.	Rt = .46	Lt = .47	Rt = 2D	Lt = 1D
29. Dr. K. Alam	33	H.S.	Rt = .56	Lt = .45	Rt = 2D	Lt = 2D
30. Dr. J. Bose	25	H.S. Car. M. C. Hosp.	Rt = .37	Lt = .32	Rt = 1D	Lt = 1D
31. Dr. S. Dutt	27	H.S.	Rt = .46	Lt = .49	Rt = 2D	Lt = 2D
32. Dr. M. Adhikari	26	H.S.	Rt = .49	Lt = .51	Rt = 1D	Lt = 2D
33. Dr. D. Kundu	28	H.S.	Rt = .47	Lt = .52	Rt = 2D	Lt = 3D
34. Dr. A. Roy Chowdhuri	25	H.S.	Rt = .39	Lt = .50	Rt = 2D	Lt = 2D
35. Dr. S. Bose	28	H.S.	Rt = .38	Lt = .38	Rt = 1D	Lt = 1D
36. Dr. G. Mondol	26	H.S.	Rt = .52	Lt = .40	Rt = 2D	Lt = 2D
37. Dr. S. Chowdhury	27	H.S.	Rt = .46	Lt = .46	Rt = 2D	Lt = 2D
38. Dr. A. Roy	27	H.S.	Rt = .50	Lt = .40	Rt = 3D	Lt = 3D
39. Dr. A. Mitra	27	H.S.	Rt = .33	Lt = .35	Rt = 2D	Lt = 2D
40. Dr. D. Banerji	28	H.S.	Rt = .40	Lt = .47	Rt = 2D	Lt = 2D
41. Dr. R. Dutt	25	H.S.	Rt = .47	Lt = .47	Rt = 2D	Lt = 2D
42. Dr. S. Bose	26	H.S.	Rt = .41	Lt = .36	Rt = 2D	Lt = 2D
43. Dr. N. Mukherjee	28	H.S. P.G.H.	Rt = .93	Lt = .63	Rt = 4D	Lt = 2D
44. Dr. Bhattacharjee	27	H.S. Seva Sadan	Rt = .40	Lt = .40	Rt = 2D	Lt = 3D
45. Rabbani	33	Compounder S.N.P.H.	Rt = .40	Lt = .52	Rt = 1D	Lt = 1D
46. Sudarsan Dutt	24	Male Nurse, S.N.P.H.	Rt = .50	Lt = .48	Rt = 1D	Lt = 1D
47. S. K. Bose	28	" "	Rt = .48	Lt = .51	Rt = 3D	Lt = 3D
48. G. A. Rahaman	25	" "	Rt = .85	Lt = .80	Rt = 2D	Lt = 2D
49. Dr. Basu	30	R.S. S.N.P.H.	Rt = .50	Lt = .63	Rt = 1D	Lt = 3D
50. S. Ahmed	21	Male Nurse, S.N.P.H.	Rt = .62	Lt = .50	Rt = 3D	Lt = 3D

The next series was of 50 people who habitually wear shoes. Hospital doctors were considered to be the best subjects for this series of investigation because they are

the people who continually wear shoes and are on their feet for long periods of time (Table II). Along with them were included a few male nurses and compounders who

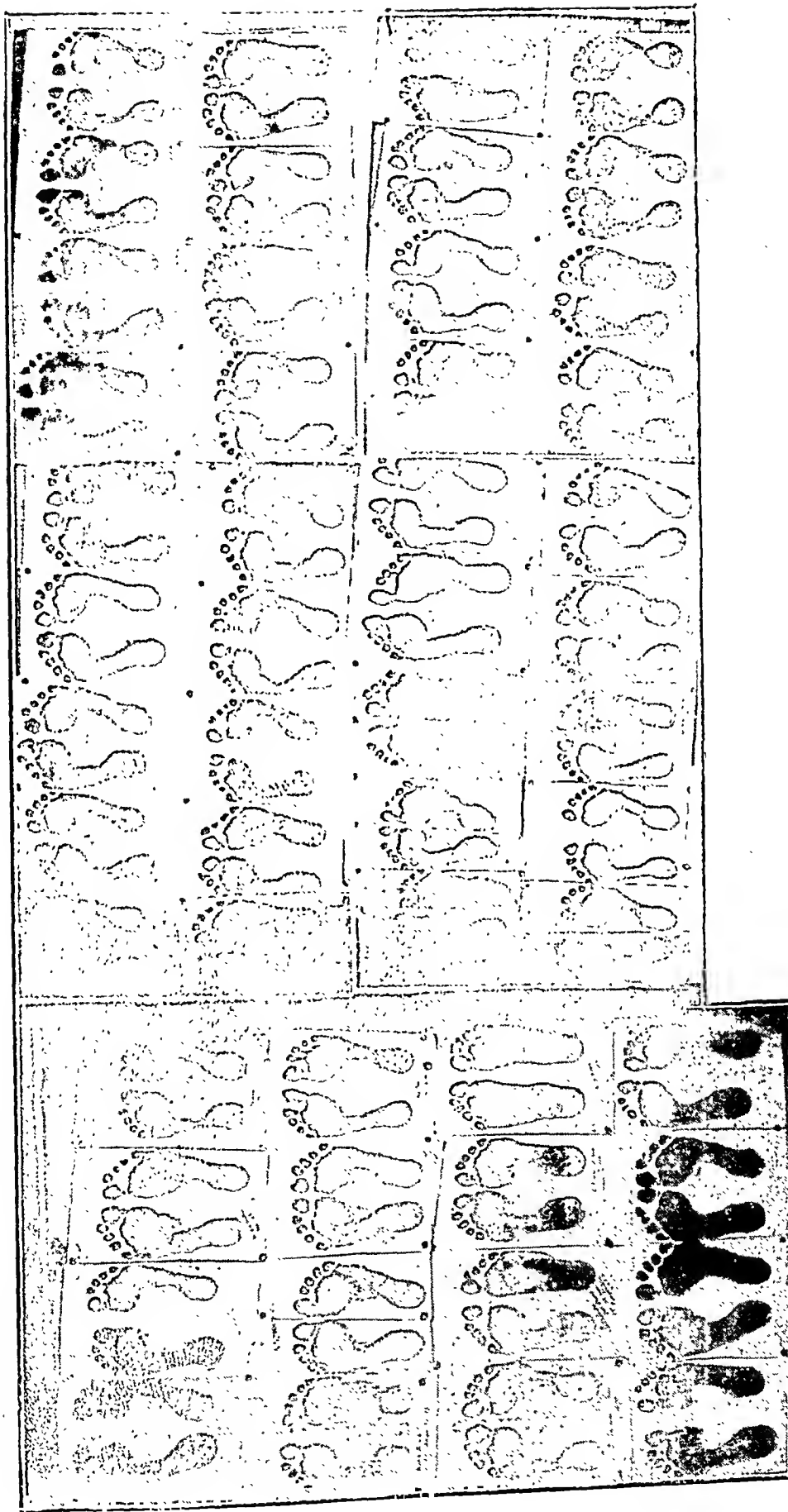


Fig. 4.  
Foot-prints of people who continually wear shoes.

also did long periods of walking and standing with shoes on. The doctors were mostly housemen belonging to the Sambhunath Pandit Hospital, Presidency General Hospital and Carmichael Medical College Hospitals. In their cases (Fig. 4) the most prominent arch and the lowest arch fraction was in the left foot of number 30 where the arch fraction was .32 and the lowest arch and the highest fraction—.95 was in the right foot of number 17. The average arch fraction was 0.523. In this series :—

Percentage of "normal" feet	..	0.96%
1st degree of the weakness	..	28.8%
2nd degree of the weakness	..	39.4%
3rd degree of the weakness	..	23.07%
4th degree of the weakness	..	4.8%

Comparison of these two series of foot prints reveals certain differences. It would be seen that the arch fraction is greater in people who wear shoes than amongst bare footed people, so that the height of the arch is lower amongst the former. This result is contrary to the suggestion that the permanent and rigid arch of the human foot is produced by restrictions of foot wear. It is also against the views of Robert Jones who says that in barefooted people there is a great development of the muscles of the foot so that the arch is masked. Other differences noted between these two sets of prints are as follows :—

(1) The percentage of so called "normal" feet is less amongst the booted people.

(2) There is increased percentage of 3rd and 4th degree of weakness amongst booted people.

These two findings and a review of the general configuration of the prints of the two series reveal that amongst people who habitually wear shoes the fore part of the foot is slightly abducted on the hind part.

An average print of a bare-footed person when super-imposed on an average print of the second series makes interesting study (Fig. 5). It would be seen that the average print of the bare-footed foot is of the shape

A in Fig. 5. The ball of the great toe makes a sharp angle with the "waist" of the foot. Also the toes are well spread out and radiate in straight lines from the heel. In an average print of the second series (B—Fig. 5) the fore part of the great toe

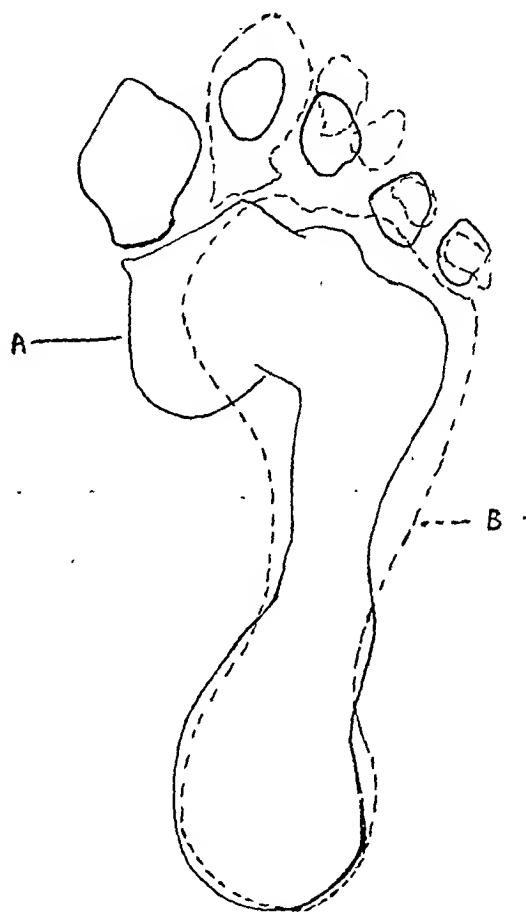


Fig. 5.

Foot-prints of Booted and Bare-footed people superimposed.

makes a larger angle with the "waist." Also the toes are more crowded together and especially the great toe, which is sharply abducted. The mechanism of the abduction of the fore part of the foot in booted people is thus explained by Lagomarsino. He says "the mechanism of flat or abducted foot consists in relaxation of the structures which maintain the longi-

tudinal arch especially the inferior calcaneo-scaphoid ligament upon which the head of the astragalus rests. As the ligament stretches the head of the astragalus becomes depressed and the anterior portion of the foot becomes abducted at the mid-tarsal joint."

That the rigid stockings used by civilised races also interfere with the natural development of the foot is emphasized by Schiemberg (1920). He says that in an ideal footwear, in addition to a properly fitted shoe which does not cause abduction of the great toe, the stocking should also be fitted with the same object in view. In weight bearing, the great toe naturally tends to abduct somewhat from its relaxed position because of the contraction of the flexor longus hallucis. Most stockings tend to prevent this abduction. The ideal stocking should have a separate hole for the great toe.

The abduction of the forepart of the foot in bare footed people is advantageous because it distributes the weight borne by the anterior two pillars of the longitudinal arch

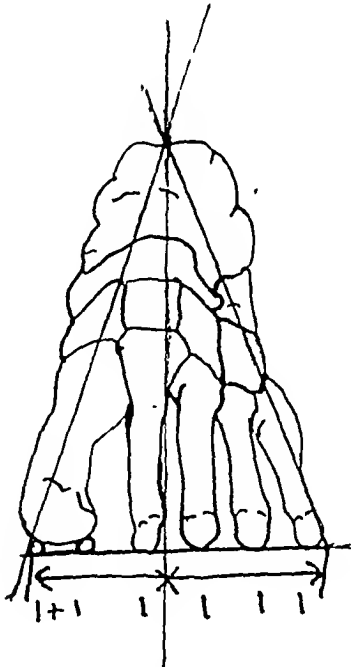


Fig. 6.

Weight distribution among metatarsal heads in normal foot during stance.

amongst all the metatarsal heads. According to Morton (1937), in normal stance, the axis of weight bearing falls between the second and the third metatarsal heads and the different metatarsals carry weight in the proportions of 2 : 1 : 1 : 1 : 1 (Fig. 6) the great toe because of its two sesamoid bones carries twice the amount borne by the other toes. Thus the foot consists of not one but five separate longitudinal arches united posteriorly in the heel. In a man weighing 144 lbs., when standing with weight equally distributed on both feet—each foot carries 72 lbs. of weight, which is distributed in the proportion of 36 lbs. to the heel, 12 lbs. to the great toe, and 6 lbs. to each of the other four toes. In locomotion, during the take off position of the

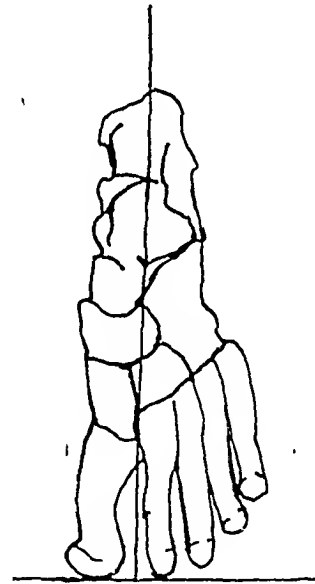


Fig. 7.

Weight distribution among the metatarsal heads during the "Take-off" position of locomotion.

foot (Fig. 7) only the first and second metatarsal of the heads come in contact with the ground and the amount of weight they carry is much increased. Here the axis of leverage passes between the 1st and 2nd metatarsal heads and the two bones act together as the fulcrum of leverage. During this period, the body weight is supported only on one foot because the other is swing-

ing forward into the advancing position. The 2 metatarsal heads carry therefore an enormous weight and the strain on the arch would be very much increased, were it not for the fact that the contractural force of the muscles takes off some of the strain from the bones and the ligaments.

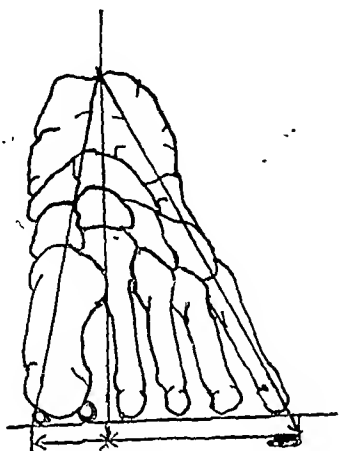


Fig. 8.

Weight distribution among metatarsal heads in Stance and in Abducted Foot.

The cumulative effect of the abduction of the forepart of the foot on the ratio of the distribution of weight among the five metatarsal heads is to make the head of the first metatarsal carry most of the strain and spare the other metatarsal heads—both during normal stance and in locomotion. In normal stance, the axis of weight bearing will pass closer to the first metatarsal or even through it, so that it alone will carry most of the weight (Fig. 8). In locomotion, similarly, the weight, instead of being distributed equally between the two metatarsal heads, is concentrated mainly on the first metatarsal.

In an adducted foot as in bare footed individuals the body weight is carried straight over the arch and over the strongest parts of the foot supported by strong ligaments. (A—Fig. 9). In an abducted foot as in booted people the same weight goes over the arch by climbing up

the outside of the posterior pillar, going over the summit diagonally from the back and then going down over the opposite side of the anterior pillar (B—Fig. 9). This is an obvious mechanical disadvantage because no arch is made to take the strain on the sides of the pillar and the ligaments and muscles being at an angle with the axis of weight bearing cannot support the arch to their best advantage. If the arch of the foot be considered as a tripod (as it is often done) resting on the three pillars, which are the heel, the head of 1st metatarsal and the heads of the other four metatarsals—one side of this tripod has to bear under these conditions continuous exaggerated strain, as the result of which it begins to give way. The arch therefore sinks and the arch fraction is increased and symptoms of foot strain appear.

To test the truth of this observation that the weight bearing strain in booted individuals falls mostly on the lateral side of the posterior pillar that is the heel and the medial side of the anterior pillar that is the ball of the great toe, I examined the shoes of certain of these doctors which have been in use for more than one year and been continuously worn (Fig. 10). It will be seen that the most marked wearing effect is present in the postero-lateral portion of the heel and the antero-medial portion of the shank. This proves that the axis of weight bearing in such cases passes diagonally across the long axis of the foot and the shoe and is an obvious mechanical disadvantage so far as the maintenance of the arch is considered.

Another disadvantage of the abducted foot is the associated crowding of the toes especially the abduction of the great toe. In a normal unrestricted foot, the toes being in line with the "five longitudinal arches" previously mentioned help the metatarsals by partaking in some of the strain. This is especially true in the case of the great toe. The mild degrees of hallux valgus present in the feet of booted individuals prevent the great toe from furnishing this desired assis-

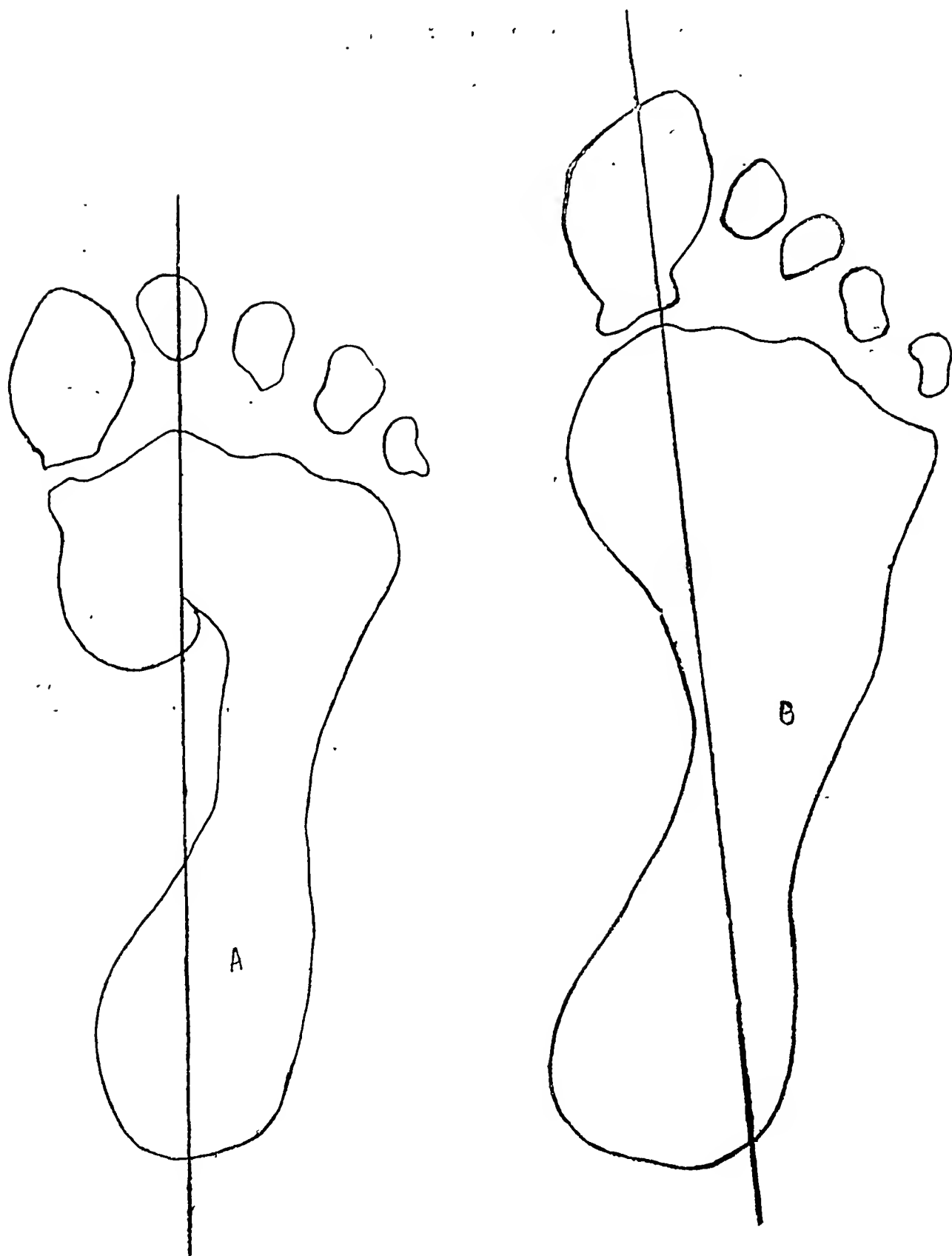


Fig. 9.  
Axis of weight bearing in Abducted and Adducted foot.

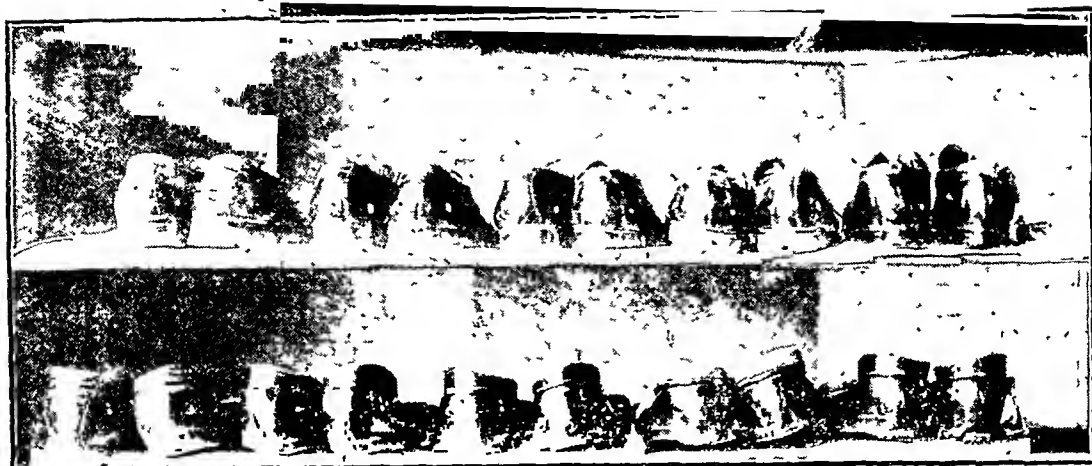


Fig 10.

Shows the wearing effect on the postero-lateral portion of the heel

tance to the head of the first metatarsal which therefore from this respect also is made to bear increased strain. It must be remembered that normally the great toe forms the buttress of the anterior part of the inner arch as it broadens the weight bearing area and thus stabilises the foot. If displaced outwards the great toe cannot grip the ground as it should and furnish a fixed point from which the muscles serve in maintaining the arch. The importance of the digits is also emphasised by Fairweather (1926) who says that nature intended the digits of the three inner toes to be carried

in one continuous curve with their metatarsals so as to continue the central part of the foot as an arch from the os calcis to the terminal phalanges of these three toes. "This would make the foot a very efficient shock absorber and is the condition met with in races who do not wear shoes." The abduction and crowding resulting from wearing modern shoes take away this helpful action of the digits and especially in the case of the great toe may be one of the determining factors in causing foot strain and depression of the arch.

*(To be concluded.)*



# CASES & COMMENTS

## A CASE OF SACRO-COCCYGEAL CHORDOMA\*

by MISS V. C. ANGULI.

The notochord is the most primitive axial skeleton in the vertebral column and is represented at an early stage in the ontogeny of all the higher vertebrates. The mesoblast around the primitive axis of the notochord develops into the spinal column. The notochord becomes enclosed in the bodies of the vertebrae and in the base of the cranium, and eventually degenerates. In adult man traces are found as the nucleus pulposus of the intervertebral disc. Occasionally, a portion of its cranial extremity persists at the base of the skull and a portion of its caudal extremity in the region of the coccyx. The remnant at the base of the skull is said to be present in about 1% of all autopsies.

Chordoma is a rare tumour arising from the remnants of the notochord. It occurs chiefly in two situations corresponding to the cranial and caudal ends of the notochord. It is a benignly malignant neoplasm with a tendency towards local recurrence and rarely giving rise to metastasis.

### CASE REPORT

A teacher, 32 years old, was admitted into the surgical wards on 4-5-46 for vague discomfort and difficulty during defaecation of two years duration. He was a well built individual in good health. He gave no history of previous illness or injury. The vague discomfort started insidiously and was associated with constipation; bowels being evacuated once in 3-4 days. There was a little pain in the ano-rectal region but it was not a prominent feature. There was no tenesmus. The patient gave no history of passing blood or mucus per rectum. He had occasional attacks of retention of urine, relieved by catheterisation. He had a sciatic type of pain shooting down to both extremities in addition to the pain in the ano-coccygeal region.

Local examination revealed a swelling in the sacro-coccygeal region. The skin was freely movable over the swelling. There was a saddle shaped area of anaesthesia in the perineum. Knee and

ankle jerks were brisk and the plantar response was flexor.

Rectal examination revealed an elastic mass, arising from the anterior aspect of the sacrum and projecting into the rectum. The margins of the tumour could not be made out definitely. It was fixed to the sacrum while the rectal mucosa was intact and was movable over it. No definite fluctuation could be elicited.

### INVESTIGATIONS

Urine: Sp. gr. 1020. Acidic. No albumin. No sugar. No Bence-Jone's proteose. Nil deposit.

Motion: Well formed. No blood or mucus. No ova or cysts.

Blood: Group 'B'. R.B.C. 5.12 millions. Hb. 105%.

W.B.C. 7200. Diff. count. P62, L32, M4, E4. B.P. 125/80.

Aspiration biopsy: The smear showed the characteristic very large vacuolated cells of chordoma with a few R.B.Cs.

On 28-6-46, under gas and oxygen anaesthesia, the following operation was carried out by Dr. C. P. V. Menon. The anus was closed with a purse string suture. An inverted T-shaped incision was made so that the vertical limb was over the median cleft and the horizontal limbs lay over



Fig. 1.

Skiagram showing the extensive destruction of the sacrum.

\*From the Surgical Wards of the Govt. General Hospital, Madras.

the gluteal folds on either side. The flaps were dissected up and the glutei were separated from either side of the sacrum. The growth was approached through the interval between the coccyx and the rectum. Anteriorly it was free from adhesions to the rectum. The tumour was removed after disarticulating the last piece of the sacrum. The cavity was plugged with roller gauze and the wound was closed in layers.

There was a rapid fall of B.P. during the operation and the pulse became imperceptible; with the usual measures his condition improved and the operation was completed. 400 c.c. of whole blood was given from the beginning of the operation and was followed by a glucose saline.

The patient died 16 hours after the operation due to secondary shock. There was no oozing from the wound.

#### MACRO-PATHOLOGY

The specimen was a pyriform tumour (5"/3") with a definite capsule which had been broken through over a small area posteriorly by the growth. The coccyx was partly embedded in the tumour. It was semifluctuant. The cut surface was composed of grey gelatinous tissue with intervening strands of fibrous tissue and scattered pools of haemorrhages.

#### MICRO-PATHOLOGY

The classical physaliphorous cells of Virchow were seen in alveolar pattern. The cells were large and polyhedral with pale staining cytoplasm

and well staining nucleus. The most characteristic feature was the presence of large vacuoles in the cytoplasm. Certain areas gave the appearance of syncytial cell masses with vacuoles.

#### DISCUSSION

Chordoma is one of the tumours where the histological features recapitulate in a striking manner the ontogenetic and phylogenetic evolution of the notochord. It is recorded in the literature that it is difficult to distinguish this from colloid carcinoma of the rectum and myxochondro-sarcoma of the sacrum. The very firm and extensive attachment to the sacrum and the integrity of the skin were the distinguishing points in favour of the diagnosis.



Fig. 3.

Photograph of the specimen.

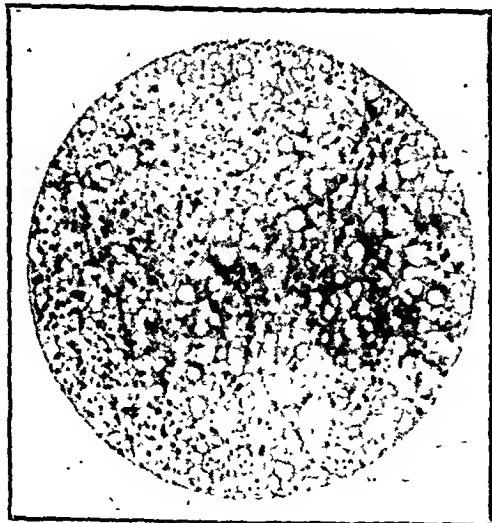


Fig. 2.

Microphotograph: the characteristic large vacuolated cells of chordoma are seen.

Thomas Howitz has studied a series of early human embryos and demonstrated the marked tortuosity of the notochord in the terminal segments due to regression of the tail in man, which was first evident in the 15.5 mm. embryo. The ectopia of the notochord results as a result of this regression,

which explains the occurrence of chordoma in the sacro-coccygeal region.

Ribbert in 1894, has proved experimentally in rabbits that escape of chordal material through insignificantly small defects made by simple puncturing of the intervertebral discs with a needle resulted in the development of tumours similar in morphology to chordoma.

The importance of trauma in the aetiology of sacro-coccygeal chordoma is mentioned by several writers, in particular by Bernard and Peyron—who suppose that severe sacrococcygeal trauma might be a factor in the liberation of cordal tissue from its normal osseous control and might even excite proliferation.

It may not be out of place to speculate that with the advent of the age of accidents

and increasing reports of herniation of the nucleus pulposus, we should expect more cases or tumours similar to chordoma arising from traumatically displaced chordal remnants present in the intervertebral discs.

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### The X Annual Conference

The X Annual Conference and the General Body Meeting of the Association of Surgeons of India will be held in Patna during the last week of December 1948. The exact dates, time and place will be announced later. All members are requested to attend. Members wishing to attend the Conference are requested to get into touch with the Local Secretary, Dr. U. P. Sinha, F.R.C.S., Surgeon, Patna Hospital, Exhibition Road, Patna.

Detailed programme, etc., will be circulated in due course.

### Subjects for Discussion

#### 10th Meeting :

##### 1. Intracranial Tumour—

Opener : Dr. A. V. Baliga, Bombay.  
 Secondar : Dr. R. N. Cooper, Bombay.

##### 2. Talipes Equinovarus—

Opener : Dr. R. Kalamegham,  
 Trichinopoly.  
 Secondar : Dr. M. Bahadur Khan,  
 Hyderabad.

##### 3. Surgical Complications of Typhoid—

Opener : Dr. V. G. Vaishampayan,  
 Sholapur.  
 Secondar : Dr. A. V. Baliga, Bombay.

#### 11th Meeting :

##### 1. Treatment of Elephantiasis and Lymph Oedema—

Opener : Dr. V. P. Mehta, Bombay.  
 Secondar : Dr. T. Kanakaraju,  
 Ramachandrapuram.

##### 2. Treatment of Hernia with Fascial Grafts and Silk Sutures—

Opener : Dr. P. Chatterjee, Calcutta.  
 Secondar : Dr. S. K. Datta, Calcutta.

##### 3. Treatment of the Bone Cavities in Chronic Osteomyelitis—

Opener : Major D. K. Sabhesan, Madras.  
 Secondar : Dr. B. N. Sinha, Lucknow.

#### 12th Meeting :

##### 1. (a) Bronchiectasis—

Dr. R. Mahadevan, Madras.

##### (b) Lung Abscess—

Dr. S. J. Mehta, Bombay.

##### 2. Intestinal Obstruction in Children—

Opener : Dr. A. E. DeSa', Bombay.  
 Secondar : Dr. R. A. Irani, Bombay.

##### 3. Sciatic Syndrome—

Opener : Dr. S. K. Sen, New Delhi.  
 Secondar : Dr. V. P. Mehta, Bombay.

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# THE INDIAN JOURNAL OF SURGERY

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SEPTEMBER 1948

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## ACUTE ANTERIOR POLIOMYELITIS

by M. G. KINI.

Poliomyelitis is a subject which has attracted very little attention in India. The existence of this disease in olden times has become evident from a study of the deformities of the limbs in Peruvian skeletons and Egyptian mummies. Egyptian Stele of the 18th dynasty as well as Spanish and other paintings, several years old, show the existence of this disease. It has not been possible to get a correct description of this disease in Ayurveda. It is probable that the brother of Catherine the Great was attacked by this disease when a year and a half old and was left a cripple. He was born in 1734. Sir Walter Scott who was born in 1773 was afflicted by this disease when he was a year and a half old and was left with a paralysis of the right leg. Underwood (1789) in England and Heine (1848) in Germany described the disease when it occurred sporadically. Little who was born in 1810 and who became the Father of Orthopaedics in England, was smitten by this disease. One of his reasons for joining the medical profession was to study the cause of this disability. After qualifying he sought enlightenment in England about himself with a desire to improve his defect. He failed. Louis Stromeyer in Hanover solved his difficulties by tenotomising the tendo-achilles of his foot in 1836. Little in his turn did the same operation for the first time in England in February 1837. In 1841 Colmer described the epidemic form of the disease in America and later in 1881 a correct description of the epidemic form was given.

In recent times, the late President Roosevelt, a long sufferer from this disease, has

carried his nation through to victory in spite of his disabilities and at the same time he has laid the foundation for investigation and improvement of treatment of poliomyelitis.

The general practitioner with poor basic training in this subject feels a sense of defeatism when he has to treat cases afflicted with this disease which may not be a constant feature in his practice. He has no facilities also to keep abreast of advances in this aspect. In his anxiety to save a catastrophe he permits anything to be done as he has no proper guidance in this matter even though he is anxious to seek it.

Having worked in this line for sometime, a scheme for the treatment of this disease on a more scientific and practical basis is suggested.

Infantile paralysis though it does not take a toll of life, yet causes serious disabilities leading to deformities and is an important factor in the production of cripples. It is an infectious disease and it affects children usually; in severe epidemics adults are also affected. It comes on with such dramatic suddenness that it makes common people in India think that this paralysis is due to an evil eye or the devil and a lot of time is wasted in invoking and appeasing the evil spirits, by incantations and sacrifices, by the wearing of charms and by the use of drugs of doubtful value, and by adopting indigenous and purposeless massage which is mechanical and monotonous.

A lot of experimental work was and is being done and elaborate researches of 40

years have elucidated that this disease is due to a virus infection. This virus is ultra-microscopic. To give a crude idea of the minuteness of this virus, it may be stated that it may take 2 to 3 million viruses queued up to make a line 1 inch long. It took a long time to find the cause of this disease. Now that the cause is found, our attention is necessarily directed to the prevention of this disease. For this, it is necessary to study the mode of spread. At one time, the hypothetical view of olfactory spread was held but this has since been proved incorrect. Squirring children were subjected to irritating douches of various types in the nose, mouth and pharynx causing annoyance to them but the children got the infection all the same. More recent investigations have elucidated that the spread occurs through the nerve terminals of the nose, tonsils, pharynx and also of the gastro-intestinal tract. It has been found that children suffer most after tonsillectomies during an epidemic and that the mortality ranges high. This shows that the raw area left after a tonsillectomy gives a free venue of entrance to the virus. Therefore it is inadvisable to have tonsillectomy operations or any operations in the region of the nose in children or adults during an epidemic.

The virus has been grown from the nasal, oral and intestinal discharges. The discovery of the virus causing intestinal infection with the usual clinical manifestations was due to the elaborate work of Dr. P. H. Harmon of the University of Chicago. Dr. R. John Paul and the late Dr. James D. Trask of Yale found the virus in sewage also.

The role of flies as carriers was demonstrated by trapping flies in the area where this epidemic occurred and the virus was cultivated from these. We all know that flies are the cause of the spread of many diseases of the gastro-intestinal tract and poliomyelitis is also considered as one of the many infections affecting the gastro-intestinal tract spread by the flies. Decayed teeth may form a source of infection and it

has been proved experimentally that if the virus is plugged into the drill hole of the tooth of a monkey, the monkey develops poliomyelitis in quick time through the nerve endings of the roots of the teeth. Investigations carried out by Dr. Hans Reese, a neurologist and Dr. John G. Frisch, a dentist of Madison, Wisconsin, in children with decayed teeth have shown the presence of the virus of poliomyelitis in these teeth. The exciting causes favouring the onset of this disease are chills, fatigue, colds, accidents—factors which should not be ignored.

By whatever route it gets into the system, this virus has a particular affinity for the grey matter of the brain and the spinal cord. Hence the word "Poliomyelitis" derived from Greek. When this grey matter is attacked by this virus, it kills those delicate cells which send out processes concerned in the neurotisation of the skeletal muscles and if these cells get destroyed by this virus, the muscles supplied by these cells will degenerate and thus the function will be interfered with. It must be clearly understood that what looks like a massive infection is always not so. The toxins of the virus may kill a few nerve cells outright and also stupefy the neighbouring cells. This is the reason why we get a false impression of a massive paralysis. The moral of this is that we should not give up hopes when we see massive paralysis but concentrate our attention on the recovery of all the muscles paralysed. By skilful attention all the muscles stupefied may recover leaving a residual paralysis which will be negligible and easily corrected.

#### THE PATHOLOGY OF POLIOMYELITIS

The first observation on the pathological changes in poliomyelitis of the spinal cord was done by Charcot (1870) who found changes in the anterior cornual cells of the spinal cord. The development of pathological observations has been slow and halting and has been attained by laborious investigations. Post-mortem examinations of poliomyelitis cases were few and far be-

tween with the result that no contributions occurred which had any bearing on the clinical symptomatology. However, the discovery of the virus of poliomyelitis has enabled investigations to be carried out experimentally in monkeys and chimpanzees. The findings have enabled us to interpret the pathological changes in human beings and to co-ordinate them with the clinical findings. More post-mortems in epidemic times have clarified some of the changes occurring in poliomyelitis. In 1908 Cadawaladar reported changes in the anterior cornual cells, ganglion cells and interstitial tissue and in 1910 Lewis reported perivascular infiltration in the vessels of the grey matter with involvement of the lateral and posterior horns in monkeys.

In 1910 Krause described inflammatory changes in the medulla, pons and basal ganglia (in addition to the changes in the ganglion cells). Blanton (1917), a few years later, confirmed in his autopsies the findings of Krause and found additional changes in the cortex and the cerebellum. Kornye (1933) described mesodermal and glial changes in the medulla in addition to the changes in the anterior cornual cells.

Peters (1938) after investigation of 17 autopsies described changes not only in the anterior horn cells, but also in the posterior and lateral horns and also in the intermediate cells and he called this the internuncial pool. The internuncial pool described by Peters is the significant observation and probably explains some of the peculiar residual occurrences of paralysis. These pools have been found in the cervical and lumbar enlargements in the lateral portion of the anterior horn in addition to the constant and segmental clusters which occupy the more medial portions. Sano and Bruce have stated "as more muscle groups appear additional clusters are added in such a fashion that the more distal muscle groups have nuclear representatives in the increasingly lateral portions of the anterior horns. It seems possible that the destruction of the cell cluster in a given cross section may mean little or nothing to the function of the

muscle which is supplied by muscular nuclear column." The medullary nuclei of some of the muscles spread over a number of spinal segments while others, for instance, the *Tibialis Anterior*, spread over a few only. This may explain why some muscles are more likely to escape complete paralysis than others. It has been proved that the pathological changes observed in the anterior horn cells are not of a permanent nature and are reversible as in the glial tissue and this probably explains the recovery of the muscles after apparent paralysis.

The physiological conception of plurisegmental control of individual muscles has been established and where this plurisegmental control is limited, the destruction of the muscle becomes complete as in the case of the *Tibialis Anterior* which remains as the only residual paralysis after an initial massive paralysis. In some cases, the symptoms of hyperaesthesia were so remarkable that it was one of the main features of the clinical observations of the parents, viz., that the children shrieked with the slightest touch. Paralysis of two or more limbs subsequently developed. These cases were also associated with spasm. Later the recovery became more and more complete leaving a small residual paralysis of the *Tibialis Anterior* muscle. Definite changes in root ganglia have been shown.

Various aspects of physiological reactions in sections from ganglia removed at post-mortems and their response to faradic and galvanic currents have been studied but in my experience these have not been quite useful. The contractions felt by the fingers have been more useful than the electrical reactions.

Chronaxia as a guide to the physiological condition of the muscle was studied during World War No. I and this may serve as a guide in the interpretation of paralysis and its recovery. Chronaxia, derived from the Greek words *chronos*, meaning time and *axia* meaning measure, was based on the fact that the strength of the stimulus ap-



plied to initiate response takes some time to produce excitability. The stimulus must last for sometime and so is defined as a galvanic threshold when an intensity of twice the Rheobase is used. Chronaxia of individual normal muscles have been worked out and found to vary between .06 and .50 milli-seconds, e.g. the average chronaxia for the Deltoid is .10 milli-seconds and for the Extensor Digitorum Communis is .30 milli-seconds; in paralysed conditions this may be 12.0 milli-seconds for the Deltoid and 18.0 milli-seconds for the Extensor Digitorum Communis.

In paralytic muscles excessive excitability may lead to fatigue and so the use of the electric current in the excitation and treatment of the paralytic muscles must be done with great care. Proebsesters (1928) made an important observation that there was no parallelism between the excitability and the tension strength of the paretic muscles.

The existence of spasm is not an indication of degeneration. The loss of inhibitory action between the internuncial group and the higher centres probably explains the spasm. The findings of Kabat and Knap (1943) are definite about the lesions in the intermediate cell group. The use of prostigmin was suggested by them to overcome the loss of the inhibitory action of the internuncial group of cells as they believed this drug relieved the hypertonus and hyperirritability and reduced in-coordination. The spasm in the muscles which Sister Kenny observed has been studied from the physiological aspect. It is believed that the spasm represents dysfunction of the intermediate cell group due to interference with impulses coming down from the higher centres which are relayed through these cells. The observations of Miss Kenny about mental alienation are probably due to lesions found in the basal ganglia and have been borne out by experimental investigations conducted by Bodain (1941).

A comprehensive experimental investigation was undertaken by Bodain and Howe (1941). Their observations on virus infection through the peripheral nerves, through

the gastro-intestinal tract, and through the nasal route are illuminating. The portal of entry through the olfactory route in man has definitely been disproved while rhesus monkeys and chimpanzees could be injected through the olfactory route. Pathological study confirmed the findings of the previous observers regarding the cranial changes.

Sister Kenny's concept of spasm, mental alienation and in-coordination have been investigated by Moldaver (1944). He stated that the so-called alienated muscles had definitely degenerated as tested by chronaxia. He also found that where there was spasm chronaxia was normal. He also stated that in-coordination occurs whenever there is paralysis due to impairment of voluntary and autonomic control and this is borne out by clinical experience.

Bodain and Howe showed the difficulties in conducting immunological experiments in animals but the conclusions arrived at are interesting. They state that it is not illogical to conclude that subparalytic immunity exists in man whereas such subparalytic virus activity cannot be demonstrated experimentally in the rhesus monkey. One may hazard that immunity in man is acquired without previous frank infection and may come either through participation of humoral factors in neutralising the virus before it is fixed in nerve cells or not inconceivably, by alterations through the humoral and metabolic factors in mucous membranes or other barriers against the entrance of the virus into the nervous system.

It is therefore suggested that immunity in poliomyelitis in man is not the result of the immunisation of the nervous system but rather of some process which prevents infective quantities of active virus from reaching nervous tissue. Neuro-tropic viruses of the type of poliomyelitis can produce varying degrees of protection in the host organisms by operating on the central nervous system or on the tissues at the portal of entry.

Billig and Harreveld (1945) in their more recent observations on nerve lesions have

found that when nerves and nerve muscular end plates are crushed the regeneration exceeds the supply of axis cylinders over and above those present before crushing. This principle was applied in partially paralysed muscles by either open crushing of the motor nerves or by subcutaneously crushing the neuro-muscular nodes by a rivet gun. This method of crushing by a hand crusher was put into operation with beneficial results in some chronic cases which had a muscular power between  $1/5$  and  $2/5$  of the normal power. These showed signs of improvement and in one case of three years' duration, definite increase of power to  $4/5$  occurred enabling the patient to get about freely without the aid of splints. There is something in this line of treatment which deserves consideration.

Environment plays an important part in preventive medicine and this aspect has to be seriously considered in the disease. It is interesting to observe that in America and Canada this disease occurs in the summer months and in epidemic form in rural areas. A more clear assessment of the environmental aspects of this disease is being investigated and tons of money are being spent in this direction. The reason for this investigation is that more common ailments like colds, occur in the winter months but the epidemics of poliomyelitis occur in the summer months. It has also been found that the disease occurs in epidemic forms in the countryside and not in the cities. In the statement of cases appended, more cases from the cities are recorded. This requires investigation. The symptoms such as fever are more severe in Indian children than those occurring in America. This also requires investigation.

How is the disease to be recognised? Unfortunately, the symptoms of this disease resemble the common ailments, a "cold in the nose," slight fever, nausea, vomiting and headache. It may manifest itself as a slight stiffness of the neck and back or may follow gastro-intestinal symptoms, or mild lung signs and is sometimes associated with

severe neuralgic pains in the extremities. The only way to decide whether it is due to poliomyelitis is by routine examination on mere suspicion. Any case with stiffness of the neck and back deserves an examination of the spinal fluid for diagnosis. This can only be possible if the public health organisation and public opinion are also centred round this disease. In order to carry out these tests it is essential to have a good public health laboratory with an expert in virus culture for examination of the disease from all children as a routine. Efforts have to be redoubled if there is a case of meningitis or a case of frank paralysis. It is pleasing to state that the first attempts at isolation of the virus by injecting monkeys have been successful from cases in Madras (C. G. Pandit).

In this connection it would not be out of place to give a review of the epidemic in the Carnicobar Islands. The Government of India having been apprised of an epidemic in Carnicobar Islands flew planes with pathologists and doctors for the relief of the afflicted and their findings have given valuable information.

Subsequently, the author with a party of doctors, nurses, masseurs, and a virus culture specialist, was sent to the islands for treatment of those afflicted by this disease. Assessment of muscle paralysis due to the disease has been made and recorded in a special chart prepared on the lines suggested by Lucille Deniels et al (see appendix, specimen case sheet). This evaluation is based on a study of 127 cases.

	Major Paralysis	Minor Paralysis	Total
Involvement of 4 limbs	42%	20%	62%
Involvement of 3 limbs	2.5%	2.5%	5%
Involvement of 2 limbs	13.5%	13.5%	27%
Involvement of 1 limb	1.5%	2.5%	4%
No limb involved—neck and thorax and cranial nerves alone affected	0.0%	2.0%	2%
Total	59.5%	40.5%	100%

Several conclusions are tentatively drawn from this epidemic :—

(1) When the epidemic attacks a virgin soil, the infection is heavy and the mortality is great. There were 209 deaths in a total of 873 cases (Col. Kapila). The statement below gives the state of affairs at the time the party reached the camp for assessment and treatment of paralysis.

(a) Total number of admissions at the camp hospital (according to register maintained since the camp hospital was started) ..	551	
Total number of deaths ..	100	
	---	451
		---
(b) Total number of inpatients assessed (these were the patients still remaining in the hospital at the time of taking charge) ..	143	
Deaths ..	2	
	---	145
(c) Total number of outpatients completely recovered — re-examined from villages ..	201	
(d) Total number of patients assessed for paralysis (cases that were discharged partially cured before taking charge) ..	71	
(e) Cases that could not be traced ..	34	
	---	306
		---
		451
		---

The following types of bulbar paralysis were recognised in this epidemic.

(a) Upper cranial group involving the 5th, 6th, 7th and 8th cranial nerves. These were not serious and the patients recovered and in a few cases were left with residual paralysis of the facial or eye muscles.

(b) Lower cranial group of nerves involving the 9th, 10th and 11th cranial nerves afforded a serious problem and were responsible for the great mortality as they interfered with deglutition and respiration.

(c) The bulbar central autonomic group, composed of the bulbar central group and the bulbar circulatory central group were also responsible for the deaths. There were some cases of bulbar cervical thoracic cord group. These remained alive but had complications of lung, etc. and two died after the author took charge.

(2) Multiple cases of poliomyelitis occurred in a family and the age-group was between 1 and 6, 6 and 10. Age group between 6 and 10 was commonly affected. There were some cases between 16 and 20 and 21 and 25.

(3) Poliomyelitis was found to be contagious and infectious. 10 per cent of the individuals in the islands were affected.

(4) Though there were a lot of flies in the island, no investigations were carried out regarding the role played by them in the causation of this disease due to difficulties in virus culture.

(5) 475 out of 873 people were abortive cases (Col. Kapila) and probably there were many other unrecognised infections without producing any symptoms to attract attention for reporting sick even during the course of this epidemic.

(6) Experimental work could not be carried out on a large scale and to a minimal extent spinal fluid examination was done. But in spite of this, due to the genius and foresight of the Director-General of Health Services, Dr. Jivraj N. Mehta, planes were flown with equipment and personnel to meet the situation. Some rhesus monkeys were flown for virus culture and investigations will be published which will open up new channels for investigation of this problem. The monkeys taken have got infected and exhibited signs of paralysis. (C. G. Pandit).

(7) There were two groups of clinical manifestations very well described by Col. Kapila. The first group had headache, nuchal pain, rigidity, drowsiness and congested eyes. These were cases which developed into various types of bulbar paralysis and paralysis of the upper limbs. The other group

had fever, headache, nuchal pain and pain in the small of the back and in the lower limbs. These patients did not look ill. If they developed paralysis it was of the lower limbs. Some of the first group of cases were extremely acute and death occurred due to respiratory failure within 12 hours of onset.

(8) Earlier observations by Casey, Aycock, Kessel and Gordon on the infection and incubation periods were well appreciated in the epidemic in the islands and the high percentage of patients in a rural epidemic have been substantiated in this epidemic as the conditions in Carnicobar Islands are of a rural type.

(9) Present methods and criteria for the diagnosis of the disease must be revised.

In a good public health organisation, anticipation of an epidemic may avert it and this is the ideal to be aimed at. America is anticipating a big epidemic and all public health laboratories are working overtime for examination of all possible sources of infection including children to see if they harbour these germs. It is a mighty effort but is essential to the prevention of the disease. It is interesting to observe that in an epidemic where this type of investigation was carried out, a large number of people were found to have positive cultures even though they had no symptoms of paralysis, an infallible sign of poliomyelitis. This goes to prove in the majority of cases they had in the early stages developed an active immunity by this infection without suffering from paralysis. Some of them act as carriers as they retain the germs and are potentially dangerous. These are the cases difficult of recognition. By wholesale investigation of the discharges and by isolation we will be able to prevent epidemics.

The disease occurs in sporadic and epidemic forms. In future to prevent the occurrence of this disease it is necessary to concentrate our attention and study the disease in four phases—(1) the pre-paralytic phase, (2) the paralytic phase, (3) the post-paralytic phase and (4) the inter-epidemic phase.

It is unfortunate that we have no authoritative figures in our country. An attempt is however being made to collect figures but the figures obtainable in general hospitals are very unsatisfactory as special concerted effort has not been directed towards this purpose. It has been found that the cases that come to the hospital are more from the cities than from the countryside. It is possible that there are more cases occurring in the countryside and due to ignorance and difficulties they are not able to seek the advice available in general hospitals. The statement appended to this paper gives an index of the incidence of this disease occurring in the districts and is based on this year's (1947) concerted effort to gather statistical records. The sporadic existence of this disease should be taken as a warning by public health organisations in India. At any time when conditions are favourable, an epidemic might occur which will be a serious problem as there are no organised clinics for this purpose in this country.

A lot of cripples due to this disease can be found scattered and are usually seen round bazaars, market places, places of pilgrimage and are the human wreckage as an aftermath of this disease. They try to make a living by exhibiting these deformities.

It is my intention to bring it to the notice of the medical practitioners, the public health authorities and the surgeons and physicians interested that a scheme of collecting information is essential to gauge the scourge due to this infection and that legislation should be enforced to make this disease a notifiable disease. Institutions must be started for treatment of this condition. Though the mortality from this disease is not high, yet the manifestations of this disease, usually lead ultimately to human wreckage.

Naturally the question arises "What is it that we have to do and what is the treatment?" The preventive aspect of the treatment is the most important thing and we know that concerted attempts are being

made in the countries where this disease occurs in an epidemic form and where public opinion is ranged high. In the course of an epidemic, all the children and contacts are examined for this type of virus by bacteriological methods by the public health laboratories. Isolation is attempted by education and sometimes by compulsion where the people are not amenable to reason. The method of preventing this disease is by developing what is called "active immunity." Some children get it as stated before by natural methods by suffering from a mild infection early in life. The least dangerous way to develop active immunity is by a vaccine injected into the child. Two vaccines were developed one of which was produced from the dead virus and the other from the attenuated virus. Experiments from the dead virus were futile and those from the attenuated virus proved dangerous and it was not used on human beings. This shows the progressive but halting nature of modern medicine. Nothing should be put on the market before trial. There are two more new vaccines on the horizon which are full of hope and promise. It is hoped that the scourge of poliomyelitis may be controlled by vaccination during the epidemic time or the children may have to be protected by routine vaccination as in the case of small-pox and diphtheria when a successful vaccine has been discovered.

Passive immunity is another aspect of treatment and is got by injecting the serum from convalescent patients. Injection of gamma globulin has been tried by Bhalke and James Perkin. The conclusion "serum in any form for all practical purposes is ineffective in the therapy of poliomyelitis" has been arrived at by them.

Specific drugs have not been found but attempts have been made which have not so far been successful. It is likely that with further experimentation and with the recent advancement in the knowledge of antibiotics, a new drug may be found for the cure of this virus infection but this can only happen by efflux of time.

Symptomatic use of drugs which control spasms of muscles is being done. The work of Dr. Nicholas Ranshoff of Longbranch, New Jersey, is an attempt in this direction. He used curare. This drug paralyses the skeletal muscles including the muscles of respiration and has to be employed carefully. It is under careful trial. It is now being used in surgery for getting complete relaxation in anaesthesia and is also being used for this condition to overcome the spasm in muscles in the acute stage of the disease. It was not possible to evaluate the scope of this drug as very few cases came early. Moreover this drug was made available in India only very recently and though opportunity existed to try this in the Carnicobar Islands it was not done due to lack of facilities in the island for counteracting the consequences.

Prostigmin is another drug and the trial of this drug has been done on a large scale in the Carnicobar Islands epidemic in treating the spastic conditions. While it has given some good in three cases out of 127, in the majority of them it proved ineffective.

The course of the infection may be divided roughly into three stages—the acute stage, the convalescent stage and the chronic stage with complete or partial wreckage of the skeletal muscular system with arrest of the growth of some bones of the skeleton in some cases producing from very mild to serious deformities associated with mild or serious contractures. In the acute stage, it is the general practitioner who has a chance of seeing and treating common ailments in children. A wise practitioner will always exclude the possibilities of two important dreadful diseases, one that takes a heavy toll of life, viz. diphtheria, and the second that maims a child for life. Immediately, poliomyelitis is suspected, a proper qualified doctor to treat this must be consulted. There is no better person for this work than a well trained orthopaedic surgeon.

During the acute stage, apart from the treatment of symptoms, attention must be concentrated to conserve the paralysed

muscles. Sister Kenny's treatment which has been used in recent times has been based on the principle that the muscles paralysed are in constant spasm with mental alienation interfering with function. She has devised the system of hot packs, hydro massage with early exercise of the paralysed muscles from the very start discarding the use of splints. Treatment by hot packs was put into practical effect in the Carnicobar epidemic with beneficial result in the cases where there was spasm.

This new treatment was in the headlines of the lay press and in some medical journals. People thought that a millenium had come for the relief of these poor unfortunate children. America, quite quick to try anything new decided to try the efficacy of this new venture. With this object, Sister Kenny was imported to America in 1940 and given all opportunities in various universities to demonstrate her treatment and the result of this investigation has been a balanced report which states that while not denying that some good can result from her treatment, the exaggerated claims put forward for her treatment are not quite justified. It is also very expensive. It therefore becomes plain that people in their anxiety to cure a hopeless case usually try to do anything that is new like the drowning man catching a straw to save himself. It is only when these new treatments and new drugs are put to the acid test by using them on a large scale, by watching the results with follow up records, will we be able to evaluate the treatment adopted. Therefore it is wrong for the lay press to advertise such treatments without sufficient trial in scientific institutions. In my opinion in the early stages, splinting, massage and hot packs have a place in the treatment. This must be done judiciously. Thus splinting, massage, exercises and probably the use of drugs like curare and prostigmin under control have a useful place in this treatment. For this a good organisation is necessary. This should consist of a hospital organisation with a good orthopaedic surgeon with a team of masseurs and

physiotherapists and a rehabilitation centre with facilities for occupational therapy. A lot of patience is required on the part of the patient, the nurse and the doctor. To get the desired result co-operative and co-ordinated effort would be necessary and for this an organisation with a suitable clinic in every teaching hospital should be provided and later in every district hospital. How can one treat the disease efficiently if the orthopaedic surgeon is to be the surgeon, the masseur, the physiotherapist and what not as it is at present.

In the convalescent stage, the treatment should be the evaluation of the muscular recovery for which a definite chart has to be drawn and each muscle tested and numerical values given, rested, worked, rehabilitated and later splinted for locomotion after having given sufficient time for the recovery of the muscle to permit of ambulation. Ambulation should not be permitted when there is a prospect of improvement in the strength of the muscles. If in the course of the treatment, the muscular power increases to  $3/5$  it must be the aim to increase it to  $4/5$  instead of permitting the patient to hobble about by splinting him for purposes of ambulation. I am quite convinced that a careful study of the muscle strength must be made and assessed to permit ambulation. Herein lies the secret leading to perfect recovery in some cases and reasonable in others. Ambulation can be permitted with splints when the prospects of recovery are poor after sufficient trial.

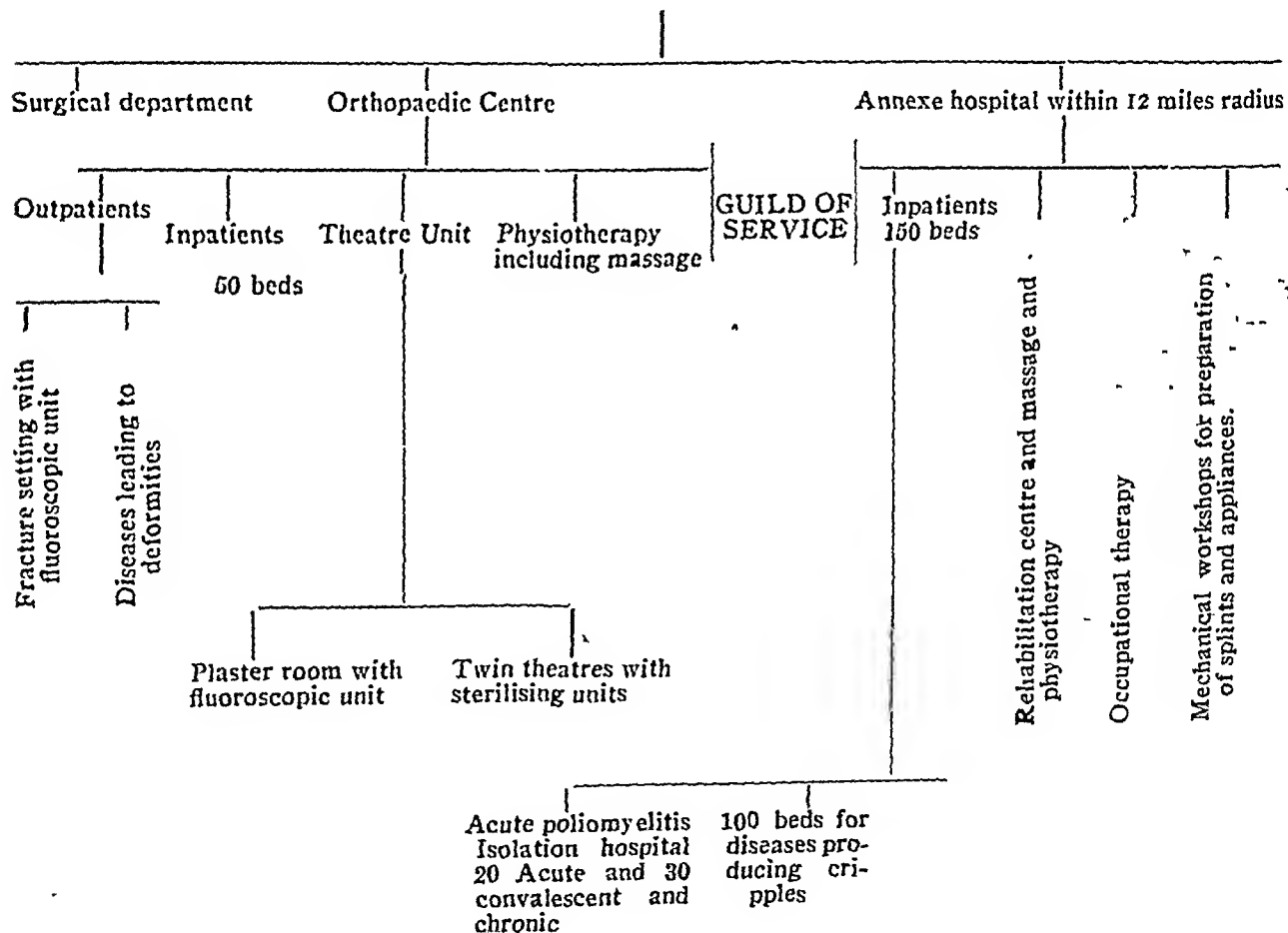
In recent times Dr. Harvey Billig and Dr. Antonie Van Harreveld of California have introduced a system of operation called Neurotripsy. It is an attempt to speed up neurotisation of the muscles by pounding the nodal points of the muscles with a special electric gun. I have tried this method and have had some dramatic results in chronic cases and probably this would be very useful during the convalescent stage, when progress becomes slow and stationery after regaining  $2/5$  of the power.

In this connection, an incident deserves mention. One lady from Bombay who is well placed and is a social service worker, had the misfortune of having a daughter smitten by this disease. She struggled to get the very best for her child in India short of going abroad and when at last she got some benefit from the treatment in Madras which enabled the child to get about without splints, she asked how she could repay her gratitude. She was advised to start a clinic for the cure of these unfortunate sufferers from infantile paralysis.

She took this to heart and has started a clinic in Bombay. This requires full public and Government support.

In the chronic stage when well established deformities occur it presents the most difficult problem for the orthopaedic surgeon to solve. Even in these cases, many can be made into useful citizens. Modern advancements in surgery and aseptic technique have helped us to tackle this problem efficiently.

### GENERAL HOSPITAL



NOTE—This scheme is envisaged for the development of orthopaedic relief to the public with particular attention to poliomyelitis and using the facilities for occupational therapy and help in the supply of splints, artificial limbs, etc. If the Guild of Service should work in the rehabilitation centre and occupational therapy centre and help to secure such splints and appliances as cannot be got through the hospitals, it would be a great help in the after care of such cases and would be a unique and welcome feature.

Operations on tendons and muscles such as tendon lengthening, tendon transplantations, re-aligning the whole muscle to undertake a different line of pull, are useful adjuncts in the cure of cripples due to infantile paralysis. For more serious deformities, operations on the fascia and bones are done. Shortening of bones, lengthening of bones, and fusion of joints, are the methods that surgery can employ for the cure of cripples. Destroying the growing point of bones of the healthy limb to keep the symmetry of the body in cases where the affected limb ceases to grow is an operation designed to meet this deformity.

The whole outlook of the treatment in the chronic stage of human wreckage is well explained by the late Sir Robert Jones, a great savant in orthopaedics:—

"It must be the aim of every orthopaedic surgeon to make a man walk if he cannot walk at all, if he can walk to make him walk better if he can walk better to restore him to normal conditions."

To gain this end, it is necessary to have an organisation as the treatment of this paralytic disease is prolonged and has to be persevered in by the patient and the doctor and it must be the duty of every nation to have its own special clinics to restore persons to their normal conditions and save them from life long deformity and misery. Institutions should be developed for the treatment of those people who are in very poor circumstances. This is the pleading before the Association of Surgeons and the public of India. The scheme shown on page 222 is recommended for adoption.

Ambroise Pare, the Doyen of modern surgical inspiration including orthopaedics has pithily stated—

"Beautiful and best of all things is to work for the relief and cure of suffering, for little do ye know your own blessedness, for to travel hopefully is a better thing than to arrive and true success is labour."

### STATISTICS OF CASES OF ANTERIOR POLIOMYELITIS

District	Total	Males	Females	Upper limbs	Lower limbs including trunk
Madras	60	35	25	3	57
Guntur	16	8	8	2	14
Kistna	9	7	2	-	9
Chingleput	8	5	3	-	8
Tanjore	5	4	1	-	5
N. Arcot	3	2	1	-	3
West Godavari	3	1	2	-	3
Kurnool	2	2	-	-	2
Nellore	6	4	2	-	6
Coimbatore	3	2	1	-	3
Mangalore	3	3	-	1	2
					(one acute case)
Bellary	2	1	1	-	2
Nilgiris	2	1	1	-	2
Cudappah	2	2	-	-	2
Anantapur	1	1	-	-	1
Trichinopoly	1	1	-	-	1
Ramnad	1	1	-	-	1
Salem	1	1	-	-	1
Malabar	1	1	-	-	1
East Godavari	1	1	-	-	1

### OTHER PROVINCES

Cochin	1
Nizam	2
Punjab	2
Bombay	2
Mysore	1
Travancore	1

Total 137 cases plus 2 address unknown=139 cases

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				Examiner's Initials					
				Date					
SCAPULA				Abductor—Serratus anterior					SCAPULA
				Adductor—middle trapezius					
				Adductors—Rhomboids					
				Elevators					
SHOULDER				Depressor					SHOULDER
				Flexors					
				Extensors					
				Abductors					
				Horizontal Abductor					
				Horizontal Adductor					
				External rotators					
ELBOW				Internal rotators					ELBOW
				Flexors					
				Extensors					
FOREARM				Supinators					FOREARM
				Pronators					
WRIST				Flexor—radial deviation					WRIST
				Flexor—ulnar deviation					
				Extensors—radial deviation					
				Extensor—ulnar deviation					
FINGERS				Flexors—metacarpophalangeal					FINGERS
				Extensors—metacarpophalangeal					
				Flexor—proximal interphalangeal					
				Flexor—distal interphalangeal					
				Abductors					
				Adductors					
THUMB				Opponens—5th finger					THUMB
				Opponens					
				Flexor—metacarpophalangeal					
				Extensor—metacarpophalangeal					
				Flexor—interphalangeal					
				Extensor—interphalangeal					
				Abductors					
CHEST				Adductor					CHEST
				MEASUREMENTS					
				Inspiration					
ABDOMEN				Expiration					ABDOMEN
				Umbilicus to Ant. Sup. Spine					
LOWER EXTREMITY				Circumference—mid calf					LOWER EXTREMITY
				Circumference—mid thigh					
				Ant. Sup. spine to int. malleolus					
				Umbilicus to internal malleolus					

Cannot walk	Date .....	Walks with crutches	Date .....
Stands	Date .....	Walks with canes	Date .....
Walks with braces	Date .....	Walks unaided	Date .....
Walks with corset	Date .....	Climbs stairs	Date .....
Other Apparatus.....			

Scoliosis and other deformities .....

Key for evaluation of functions of muscles

5	N	Normal
4	G	Good
3	F	Fair
2	P	Poor
1	T	Trace
0	O	Zero
S or C	SS or CC	Spasm or Contracture

Complete range of motion against gravity with full resistance.  
 Complete range of motion against gravity with some resistance.  
 Complete range of motion against gravity.  
 Complete range of motion with gravity eliminated.  
 Evidence of slight contractility. No joint motion.  
 No evidence of contractility.  
 Spasm or severe spasm.  
 Contracture or severe contracture.

LEFT

RIGHT

					Examiner's Initials														
					Date														
NECK					Flexors														NECK
					Extensors														
					Flexor														
					Extensors—thoracic														
TRUNK					Extensors—lumbar														TRUNK
					R. ext. obl. L. int. obl.				Rotators	L. ext. obl. R. int. obl.									
					Elevation of pelvis														
					Flexors														
					Extensors														
					Abductor														
HIP					Adductors														HIP
					External Rotators														
					Internal Rotators														
					Sartorius														
					Tensor fasciae latae														
					Flexor—outer hamstring														
KNEE					Flexors—inner hamstrings														KNEE
					Extensors														
					Plantar-flexors—Gastroc. & Soleus														
ANKLE					Plantar-flexor—Soleus														ANKLE
					Invertor—Anterior tibial														
					Invertor—Posterior tibial														
FOOT					Evertor—Peroneus brevis														FOOT
					Evertor—Peroneus longus														
					Flexors—metatarsophalangeal														
					Extensors—metatarsophalangeal														
TOES (4 lateral)					Flexor—proximal interphalangeal														TOES (4 lateral)
					Flexor—distal interphalangeal														
					Abductors														
					Adductors														
					Flexor—metatarsophalangeal														
HALLUX					Flexor—interphalangeal														HALLUX
					Extensor—interphalangeal														

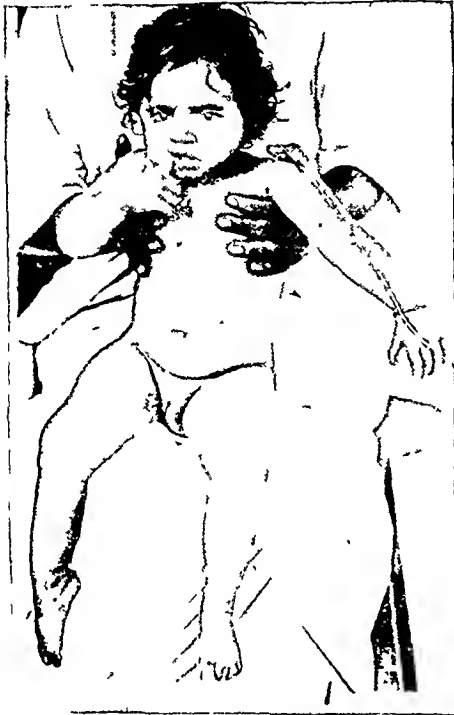


Fig. 1.

Fig 1. Illustration showing the paralysis affecting the foot. Note the deformity.

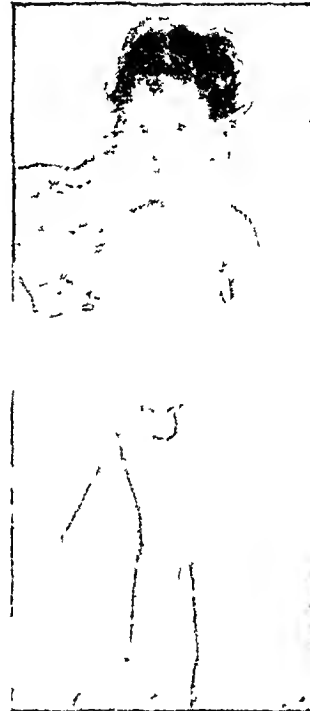


Fig. 2.

Fig. 2. Illustrates paralysis affecting only the knee muscles.

These two are examples of children who suffer from Poliomyelitis with deformities of a minor nature which may be prevented by modern methods of treatment.



**Fig. 5.**

Fig. 6.

Figs. 3. to 6. Are illustrations of paralysis in the lower limbs showing the deformities that occur as a result of the disease.



Fig 7.



Fig 8



Fig. 9

Fig 7. Is an illustration of a girl who was paralysed in both the lower limbs and had to crawl on fours. She had five operations, two on the feet, one in the region of the knees. After these operations, the child was able to stand up.

Figs. 8. & 9. Show a child who is able to walk with the help of a caliper.



Fig. 10.



Fig. 12



Fig. 11.

Figs. 10. to 12. Are illustrations of shoulder girdle paralysis and the treatment adopted on a splint constructed with plaster of paris.

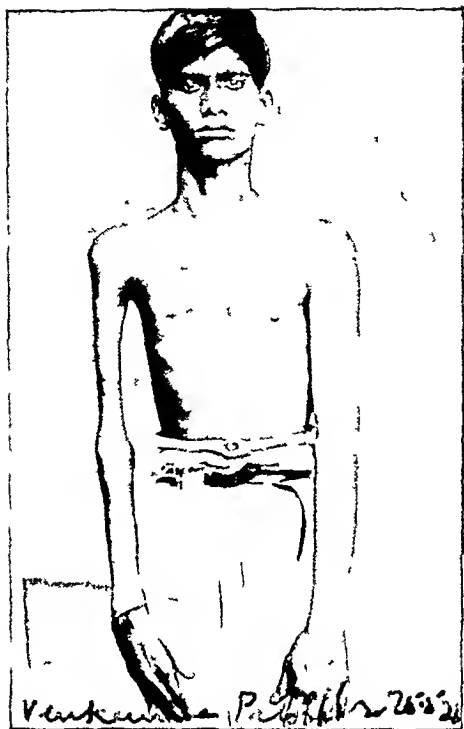


Fig 13.



Fig. 14.

Fig. 13. & 14. Are examples of the paralysis of the shoulder girdle and upper limb. The paralysis of upper limbs is more serious than the lower limbs as the muscles do not recover as well as in the lower limbs.

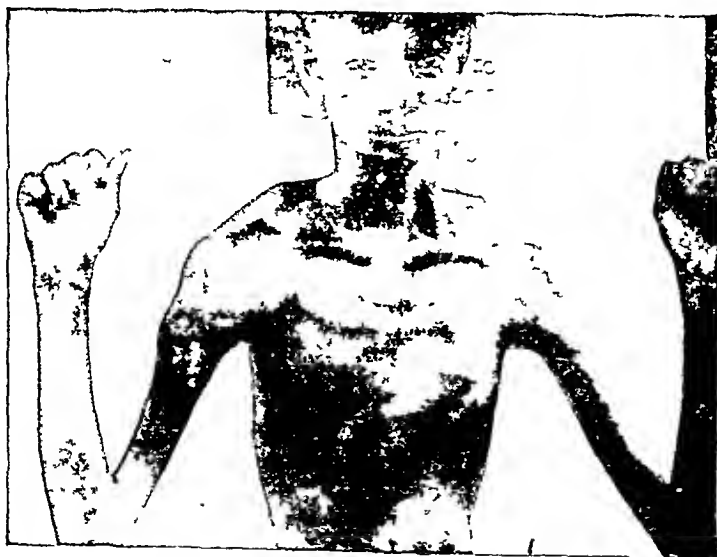


Fig 15

Fig 15 Is an illustration of an adult whose shoulder girdle was paralysed but he can compensate for the paralysis by trick movements and is an example of the method adopted in re-education of muscles for getting some function of the limb. Had this man been under proper treatment the restoration of function might have been through a greater range



# SOME OBSERVATIONS ON THE PHYSIOLOGY AND PATHOLOGY OF THE GALL-BLADDER

by V. M. KAIKINI.

One usually finds that in pathological conditions of the gall bladder, infection is always given primary importance; and anatomical abnormalities or physiological disturbances without which infection by itself cannot play its part, are rarely taken into consideration. For example it is common knowledge that many people harbour *B. Typhosus* in their gall bladders and go about as typhoid carriers without themselves suffering from any symptoms of cholecystitis. This is due to the fact that these people have an anatomically and physiologically normal gall bladder, which cannot be damaged by *B. Typhosus*. By experience it is found that a congenital anatomical abnormality and disturbance in the physiological working of the biliary system are the primary factors in lowering the resisting powers of the gall bladder so that it could be easily damaged by infective organisms.

## ANATOMICAL ABNORMALITIES OF GALL BLADDER

(1) *Intrahepatic Gall Bladder*.—Normally the gall bladder lies free over the surface of the liver fixed to it by a fold of peritoneum. But in this abnormality some portion of the fundus is found buried in the substance of the liver. Two cases were noticed by me of this type.

Case 1. (Fig. 1.) A female patient admitted for persistent and severe pain in the right hypochondriac region for the last four years. History of severe attack of typhoid about nine years previously. The gall bladder was found to be atrophied with the wall very much thickened and fibrosed and the fundus firmly fixed to the wall of duodenum by a thick fibrous band almost cartilaginous in consistency which had to be sawn through to set it free. The viscus contained a big stone. The fundus was

found to be buried to about half of its circumference in the substance of the liver,

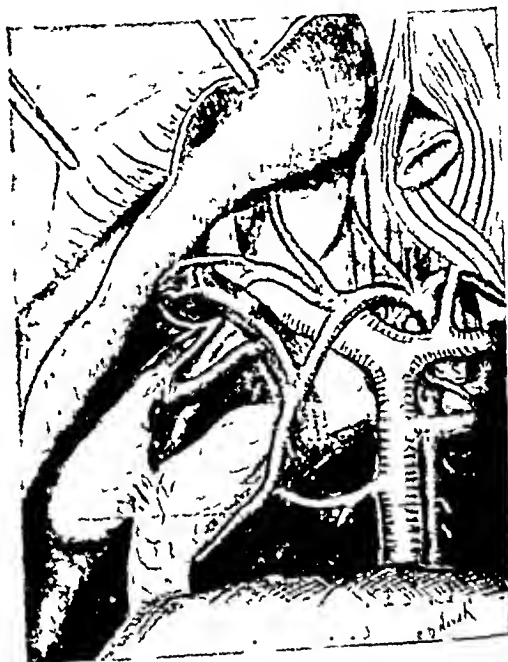


Fig 1.

Gall-bladder fibrosed and atrophied. The fundus is slightly buried in the substance of the liver and is firmly adherent to the wall of the duodenum.

and had to be dissected out of its bed with the knife. Typhoid infection on the top of the congenital anatomical defect must have given rise to the inflammatory condition of the viscus.

Case 2. Patient, a nurse, was admitted for pain in the epigastrium and right hypochondrium. Appendix had been removed some time before with temporary relief. The attacks of pain were intermittent and spasmodic in character, with tenderness over the gall bladder region. On opening the abdomen the gall bladder was found to be free from adhesions and normal in colour and appearance, but was small in size lying parallel to the anterior margin of the liver, with some portion of the fundus lying

buried in the substance of the liver. The gall bladder was not removed as it did not show any signs of damage. In this case superimposition of some infection on top of this anatomical abnormality is sure to give rise to pathological condition of the gall bladder.

(II) *Absence of the Cystic Duct.*—Case 3. (Fig. 2.) In this case the fundus of the gall bladder was found to open into the common bile duct directly and the cystic duct was found to be absent. The patient was admitted for jaundice and persistent abdominal pain of over six years' duration. On opening the abdomen the gall bladder was found to be enormously enlarged,



Fig. 2.

An enlarged gall-bladder full of adhesions and directly communicating with the common bile duct without the regular cystic duct being present.

fibrosed, thickened and with a portion of its fundus buried in the substance of the liver. The cystic duct was absent and the fundus was directly opening into the common bile duct. The whole gall bladder which contained three stones was removed. But a small portion of the wall which was buried inside the substance of the liver and was firmly fixed in it was left behind. The

patient died on the 12th day of the operation. Leaving behind a portion of the septic wall of the gall bladder gave rise to pyelephlebitis which caused his death.

(III) *Abnormally narrow lumen of both the Cystic and Common Bile Ducts.*—Case 4. Patient aged 25, came with a history of abdominal pain on the left side of the umbilicus with belching and intermittent pain in the cardiac region. Trouble started with cardiac pain followed by dyspeptic symptoms. Cholecystography showed defective filling. On opening the abdomen the gall bladder was found to be free from adhesions and practically normal in appearance. But the cystic and common bile ducts were found to be extremely narrow. The gall bladder was removed as it has been found that removal of the gall bladder causes gradual enlargement of the lumen of the common bile duct. The cardiac pain completely disappeared soon after the operation and the dyspeptic symptoms went on improving gradually. When seen in July 1947, (eight years after the operation), the patient was practically free from his distressing abdominal symptoms and his digestive power was gradually getting better.

(IV) *An abnormal branch of the Hepatic Artery* passing through the fundus of the gall bladder giving rise to its pathological condition. Many varieties of abnormalities have been mentioned in arteries supplying the gall bladder and the liver. According to Reginald Jackson in 20 per cent of cases the blood supply of the right hepatic lobe comes directly from the superior mesenteric artery and this hepatic branch may meander so far as to lie across the cystic duct. If mistakenly ligated high temperature and death may follow. In some cases the right hepatic artery runs parallel to the cystic duct and then arches behind it, at the neck of the gall bladder to enter the right lobe of the liver. Before doing so it gives off the cystic artery. Many other abnormal courses of the cystic artery have been noted.

In Case 5 (Fig. 3), the cystic artery was normal; but an abnormal branch of the

right hepatic artery ran parallel to it and passing along the wall of the gall bladder, terminated in the right lobe of the liver. The gall bladder was very much atrophied with its walls fibrosed and thickened. It was impossible to set the artery free from the walls of the gall bladder, as it was

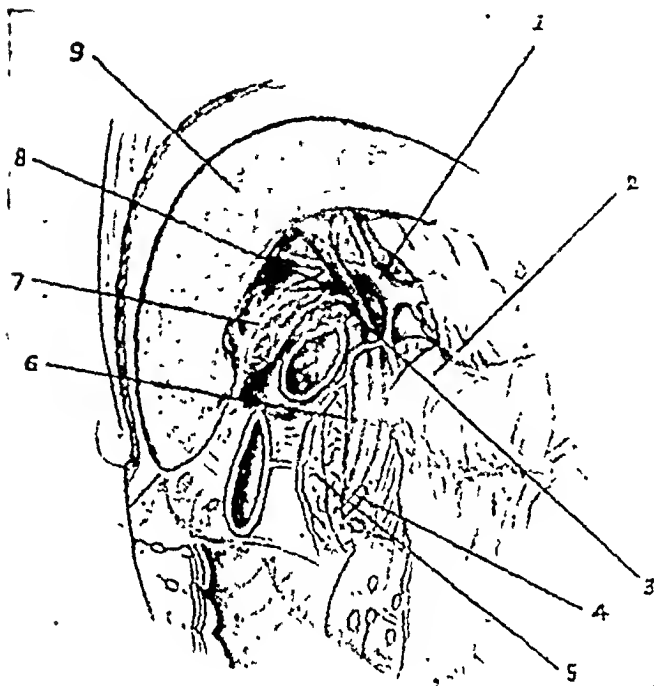


FIG. 3.

Gall-bladder is atrophied, coat is thickened and changed in colour. The aberrant artery is shown as a branch of the right hepatic artery going along the wall of the gall-bladder and entering the right lobe of the liver: (1) hepatic artery, (2) pylorus, (3) cystic duct, (4) pancreatic duct, (5) pancreas, (6) common bile duct, (7) aberrant branch of hepatic artery, (8) cystic artery, (9) liver.

firmly adherent to it. It was ligated and cut and the gall bladder removed. The patient who was suffering from severe abdominal pain for over six years was completely free from the symptoms. Apparently the right lobe of the liver was not deprived of its blood supply, by the ligation of the vessel and the artery must have been an accessory branch from the right hepatic artery, as the patient was seen in perfect health one year after the operation.

Many other anatomical abnormalities of the gall bladder such as (i) floating gall bladder (ii) double gall bladder arising from supernumerary pockets from bile ducts, (iii) bilocular gall bladder, have been described, which may be the congenital etiological factors in causing a pathological condition.

#### PHYSIOLOGICAL ABNORMALITIES

It need not be emphasized that more attention should be paid to the normal and abnormal working of the nervous system as etiological factors, in the pathological conditions of the gall bladder and the duodenum. The bile stream is subjected to the following influences:—(1) The secretory pressure of the liver. (2) Contractility and storage function of the gall bladder. (3) The collum cysticum located within the neck of the gall bladder. (4) Valves of Heister within the cystic duct. (5) Respiratory effects on intra-abdominal pressure. (6) Sphincter of Oddi. (7) Duodenal tonus and motility.

The extra-hepatic biliary system has a double nerve supply, parasympathetic fibres from the vagus nerve and sympathetic fibres from the splanchnic nerves. A controversy still remains unsettled as to which of the two carries motor and which inhibitory impulses. The most plausible explanation seems to be that for rhythmic movements of the musculature of the viscera a systematic co-ordination in working should exist between the sympathetic and parasympathetic nervous systems; most probably the sympathetic nerves control the working of the vagus nerve.

When the gall bladder contracts the sphincter of Oddi is relaxed. The maximal intra-gall-bladder pressure does not exceed the secretory pressure of the liver, thereby permitting a free flow of hepatic bile into the gall bladder, which occurs during the fasting period when the sphincter is closed. With the first meal containing a stimulus for the gall bladder contraction, the sphincter relaxes and the intraductal pressure

falls to a level, against which the gall bladder can now easily contract and evacuate itself either by reflex or the same factor which makes the sphincter open itself. The normal physiological stimulus for the evacuation of the gall bladder, is the passage of gastric chyme following the ingestion of fat or protein into the duodenum.

The exact pathways which carry the nervous impulses of this mechanism are not known, as yet. They certainly participate in the general balance or imbalance of the vegetative nervous system as a whole. Any vegetative function depends upon the antagonistic action of the sympathetic and parasympathetic impulses (Rothlm). The autonomic nervous system is governed by the higher centres of the central nervous system.

Thus in the pathological conditions of the gastro-duodenal area or gall-bladder, the vegetative nervous system, influencing the working of the sympathetic and parasympathetic nerves through psychic impulses, plays a very important role. Both these nerves start the process of digestion, by their control over the motor and secretory functions of the gastroduodenal and biliary systems. This process is known as the duodenal reflex. Various theories have been put forward about the working of this reflex and various descriptions given. There is no doubt that dysfunction of this important reflex is a very important etiological factor in the pathological condition of the gastro-duodenal area like peptic ulcer, and of the biliary system especially cholecystitis. The stimulation of the vagus by psychic impulses (through the vegetative nervous system) or food, stimulates the glands (secretory) of the stomach and the liver, causing secretion of hydrochloric acid in the stomach and bile in the liver cells. At the same time the motor fibres cause the rhythmic contraction of the pyloric sphincter and fundus of the gall bladder and relaxation of Oddi's sphincter, thus pumping the bile into the duodenum. For the normal process of digestion a properly

functioning duodenal reflex is essential. The duodenal reflex is disturbed by (1) Dysfunction of the vagus due to poisons such as pilocarpine, physostigmine, nicotine, and toxins such as *B. typhosus*, *B. coli*, streptococcus, etc. or faults in diet as regards time and quality. (2) Dysfunction of the vegetative nervous system due to psychic disturbances such as anxiety, worry, neurosis, etc.

Westphal blames the dysfunction of the vegetative nervous system. Gundermann suggests that excitement such as anger or emotional upsets might act as a cause. He located disorders of this nature in the region of the third ventricle of the brain. These emotional crises act on the vegetative nervous system according to him. Functional and organic changes chiefly in the hypothalamic region of the brain undoubtedly influence secretory activities in the epithelial cells of the gall bladder and gastroduodenal mucous membrane, probably largely through alterations in the vasomotor control. The exact mechanism by which attacks of hormonally excited neurogenic dysfunction associated with emotional upsets causes the walls of the undamaged gall bladder to absorb bile acids, selectively, and at the same time to secrete a pathological mucoid substance has not been demonstrated.

According to Brainbridge and Dole, the nervous pathways which carry the nervous impulses of the biliary mechanism participate in the general balance of the vegetative nervous system as a whole. Any vegetative function depends on the antagonistic action of the sympathetic and parasympathetic impulses. The autonomous system is governed by the higher centres of the central nervous system. The liver is, in addition to producing digestive secretions, the organ through which most of the products of digestion pass before reaching other tissues of the body. In this capacity it can be considered as a filter of the blood that has passed through the organs that have to do with the digestion and absorption of a large percentage of the food sub-

stances that enter the body. The pathway between the gastro-intestinal tract and the liver is the portal circulation. All the blood in the gastro-intestinal tract, spleen and pancreas, except the small amount that drains through the collateral channels passes through the liver. The portal circulation is therefore of considerable importance, not only in consideration of co-ordination of functions of the gastro-intestinal tract, and the liver, but also in relation to the development of pathological conditions in the two organs. Beginning in the foetal life many of the substances that reach the other tissues of the body must pass through the liver.

Infection through the hepatic artery is rare; but it is more common through the portal vein and lymphatics. In cholecystitis there is associated inflammation of the liver (in the interlobular sheaths—pericholangitis), the right lobe being more affected near the gall bladder. In the majority of cases cholecystitis represents intra-mural infection from a liver already inflamed in the interlobular and periportal tissues through infection brought by the portal vein. There is well recognized association of biliary tract infection with the lesion of portal system—appendicitis, peptic ulcer, etc. The liver being a bacterial filter where poisons are dealt with the sequence of events will be (1) infection of liver cells, (2) destruction of parenchyma and infection of bile & (3) infection of gall bladder through blood vessels, lymphatics or direct contact. In the portal system there are two streams, one derived from the alimentary canal, and the other from the spleen. The organisms from the blood are arrested by the mesenteric glands and the epithelium of the liver sinuses. Destruction of the organisms by the Kupfer's cells leads to filling up of the perivascular spaces with leucocytes and finally hepatitis. The organisms within the portal current may be derived from the spleen. The association of the diseases of the liver and of gall stones with diseases which seem to have their origin or chief development in the

spleen has recently become clearer. In haemolytic jaundice 60% suffer from cholelithiasis. With splenic anaemia both cirrhosis of liver and gall stones are associated. In cholelithiasis the spleen is found enlarged. It is from the spleen that the infection is derived. Splenectomy for recurrent cholelithiasis may be found necessary, when the bile ducts (including those in the liver), are filled with mud and fine stones. One of the functions of the spleen is to filter out micro-organisms and toxic substances from the blood stream and send them to the liver for destruction. Stones especially calcium bilirubin ones owe their origin to increased destruction of red cells in the spleen.

#### CHOLESTEROL METABOLISM

The disturbances in the metabolism are:—  
(1) Cholesterosis of gall bladder. The papillae of the viscus are laden with cholesterol esters. This is not an infective condition. Cholesterol is held in bile just as urea in urine. (2) Cholesterol increases in blood in pregnancy, post-infectious states nephritis, and hepatic diseases.

Four factors (1) congenital anatomical abnormalities, (2) metabolic disturbances, (3) infection and (4) biliary stasis due to disturbed physiological function, especially neurogenic in origin, are of primary importance in the development of cholecystitis and cholelithiasis. Mere disturbance in cholesterol metabolism acting by itself would give rise to strawberry gall bladder which is now supposed to be a noninflammatory condition. An infected gall bladder containing *B. Typhosus* or *B. Coli* in the bile, may not show any signs of cholecystitis. So also stasis of bile due to spasm of the sphincters or gall bladder muscle caused by nervous (vagus) disturbances, may give rise to occasional abdominal pain, such as 'biliary dyskinesia' of Westphal, without any inflammatory condition of the gall bladder being present.

These four, especially two factors viz. (i) biliary stasis and (ii) infection are found in the majority of cases to be the

most common factors in the etiology of cholecystitis. Where stones are present cholesterol metabolism also plays an important role. Congenital anatomical abnormalities are naturally found in a few cases. In any case mere infection would not give rise to a pathological condition of the gall bladder unless damage already exists in the wall of the viscus, due to one of the above factors. Moreover the pathological changes are mainly intramural, as the infection is mainly haematogenous and the walls of the gall bladder have a rich blood supply.

Wolfer has proved that under certain circumstances pancreatic juice in man could and does pass by reflex into the gall bladder and cause pathological changes which vary from oedema to complex necrosis of the walls.

#### THE THYROID AND GALL BLADDER DISEASE

Hinton reviewed 43 cases of hypothyroidism which presented typical symptoms of peptic ulcer. Rigel, Ravdin, and Morrisson, noted that thyroid disorders are frequently associated with gall bladder disease. A high cholesterol level is found in both gall bladder disease and hypothyroidism. Epstein and Gainsborough and others have noted an inverse relationship between thyroid function and blood cholesterol level and many believe that blood cholesterol level is a more accurate index of thyroid function than the basal metabolic rate. Both hypothyroidism and cholelithiasis are much more common in females and both diseases are associated with obesity. Many patients with gall bladder disease present typical picture of hypothyroidism especially females, whose thyroid is apt to be depleted during pregnancy and with the onset of menopause, a time when gall stones occur. In thyroidectomized animals the gall bladders were found to be distended, the bile contained in it was found to be thick, and viscid, with large amount of thick brown precipitate. Some of these gall bladders contained numerous black concretions in them consisting of traces of calcium and cholesterol. Hypercholester-

laemia is found to develop in thyroidectomized animals and is present in cholecystitis. Thyroid extract or a normally functioning thyroid gland is essential for normal gall bladder activity. Digestive complaints such as nausea, epigastric pain, and constipation are associated both with hypothyroidism and chronic cholecystitis. Both diseases show a basal metabolism rate of —10 or below.

Many a time it is found that a person who has had no regular attack of amoebic dysentery develops an amoebic abscess of the liver. It has been proved that this is due to the patient being infected with amoebae, which have not given rise to any pathological symptoms of colitis, the infection being an incipient one. Similarly typhoid bacilli which are responsible for the infection of the gall bladder in a fairly large number of cases, may give rise to cholecystitis in a patient, who does not give any history of a regular attack of typhoid fever. The following is a case of this type.

Case 6. B. aged about 16. Male. Patient came for constant pain and tenderness in the gall bladder area, well marked debility, distension after meals and loss of appetite. Joint pains and sensation of pins and needles in the roots of the hair of the head present. About two years back the patient developed slight fever for four days which stopped but was followed by severe jaundice with vomiting and abdominal pain. The jaundice disappeared with treatment but the symptoms given above continued. About the time that he got this attack there were about two or three cases of severe typhoid in the family. Most probably the patient himself got infected by the typhoid bacilli without showing any classical symptoms of typhoid fever—the attack being an incipient one—and the bacilli got lodged in the biliary apparatus giving rise to an attack of cholecystitis.

#### DIABETES AND GALL-STONES

Says Roberts, "apparently more diabetic patients have gall stones than non-diabetic patients. All investigators are agreed that

diabetes when it occurs follows the presence of gall stones, but none has proposed that diabetes causes them to form or that the two diseases have a common cause. In nearly every case of cholecystitis the appendix is found to be pathological and it is desirable to remove the appendix when the gall bladder is being removed for its pathological condition. Many a time the appendicular symptoms are so much prominent that they manage to mask the pathological condition of the gall bladder and a wrong diagnosis follows. In the book "Inter-relation of abdominal disease" by the Hungarian doctor Elemer Fourai, Hurst says in the foreword "There has been in the past too much tendency to regard the many diseases of the abdominal viscera as isolated phenomena. Derangement of one has far reaching effects on the others. It is for this reason among others that the removal of a pathological appendix, except for acute attacks often leads to little or no improvement in the patient's condition. Some physicians doubt whether such a condition 'appendicular dyspepsia' really exists. The fact that an appendectomy scar is one of the commonest physical signs of chronic cholecystitis is not so much an indication that a wrong diagnosis has been made in the first instance, as that the case has been judged from a too narrow point of view".

Herein are quoted two cases in which badly affected appendices were removed under the impression that they were responsible for the symptoms resembling those of cholecystitis, but the symptoms still persisted, as they were really cases of cholecystitis.

Case 7. K. Age 42. Patient was brought by a medical man for abdominal pain of some years' duration. Pain was most marked in the epigastric and umbilical regions and accompanied by nausea and well marked dyspepsia. Tenderness was present in both appendicular and gall bladder areas although it was more marked in the appendicular area. The doctor at first hesitated to show me the skiagrams which he had with him before I gave my

diagnosis, but I took them and found the shadow of a typically pathological appendix. The doctor himself was suspicious of cholecystitis and did not want me to be prejudiced in favour of appendicitis, by seeing the skiagram before examining the patient clinically. But the marked tenderness and the shadow of a pathological appendix made me think that it was a definite case of appendicitis and the gall bladder symptoms were secondary to appendicitis. So I removed the appendix which was found to be thick and fibrosed. At the same time I warned the patient that if the gall bladder symptoms did not disappear a second operation might be necessary. The patient was free from symptoms of pain for over four years, although he used to complain of sensation of retching and discomfort in the epigastrium off and on. After that he started getting more severe pain in the gall bladder area with marked distension. I advised him to have his gall bladder removed. But he has not so far submitted to the operation. In this case the skiagram of a pathological appendix and the well marked tenderness in the appendicular area made me think that the gall bladder symptoms were secondary to the appendicular condition. In fact both the gall bladder and appendix ought to have been removed at the same time.

Case 8. G. Age 24. Patient came for chronic abdominal pain with distension of some years duration. Tenderness was present both in the gall bladder and appendicular areas. In this case also the skiagram which the patient had brought with him showed a very pathological appendix, which was found lying coiled up. The appendix was removed and the patient was found to be free from symptoms for about a year. Then he started getting pain and distress in the epigastrium. He went to the Mission hospital Wai where he was X-rayed to find out if the trouble was due to a peptic ulcer, which was excluded. He came to me again and I found that the trouble was due to cholecystitis and advised him to have his gall bladder removed. He did not get operated. He saw me about



four years later complaining of extremely severe pain in the epigastrium for which he was taking morphia every day. His doctor told me that he consulted a surgeon in the interval, who diagnosed it as a case of peptic ulcer and gastro-jejunostomy was done. Since then he has been getting extremely severe pain which has made him contract morphia habit and he has become an inveterate addict to it. He consulted some other surgeons who diagnosed it as a case of jejunal ulcer although the skiagram taken lately does not show that lesion. In this case also the skiagram of a well marked pathological appendix misled me and only appendicectomy was done while excision of both the appendix and gall bladder was indicated.

In a fairly large number of cases patients who come with typical symptoms of cholecystitis of some years' duration have been found to have a normally filling gall bladder on taking a Roentgenographic plate although clinically the patient has all the symptoms of a pathological gall bladder, and the diagnosis is confirmed at the operation table.

Case 9. The patient was seen in 1925 for an acute attack of biliary colic which was treated with remedies for gall bladder trouble and some improvement followed. But he was not seen for some years till 1932 when he came with an attack of severe cholecystitis with jaundice, fever, and pain. The skiagram showed a normally filling gall bladder. Operation was done after the acute attack subsided and a typically pathological gall bladder was removed. Since then the patient has been keeping very good health.

On the contrary in some cases the patient with all the symptoms of typical cholecystitis has an X-ray taken which shows a pathological gall bladder, but on opening the abdomen the gall bladder looks apparently normal—free from adhesions, normal in colour etc. But cholecystectomy gives complete relief to the patient. It is such cases that the position of the surgeon is rather embarrassing. Says Catell "A gall

bladder should be removed when there is a history suggesting cholecystic disease, when the cholecystograms are suspicious looking and show pathology and when other gastrointestinal diseases are ruled out." According to Verbrycke "Following cholecystectomy in 32 cases of relatively normal appearing gall bladders the end results were traced for years. A surprising percentage of satisfactory results was obtained without operative mortality. It appears perfectly possible to obtain as good results from cholecystectomy in properly chosen cases of relatively normal appearing gall bladders as in the more diseased gall bladders. The patient must be carefully studied and the operation decided upon, only after mature judgement. Symptoms and tests should correlate. If the symptoms and tests warranted an operation, and no other satisfactory cause of discomfort can be found at operation, not only is it perfectly justifiable to remove the gall bladder—even though it appears fairly normal—but excellent results may be anticipated."

Lastly increasing importance is being given to the intimate connection between the pathological condition of the gall bladder and disorders of other important viscera, especially the kidney and heart.

*Kidney.*—It has been generally believed that the liver when severely injured by disease or trauma produces a soluble toxin, which causes definite pathological changes in the kidneys. There is an increase in the blood of the non-protein nitrogen, creatinine and albumin, pus, and casts in the urine.

*Heart.*—Many times diseases of the gall bladder and coronary disease coexist. Convincing electro-cardiographic evidence of improvement at times has been observed to follow cholecystectomy. Many investigators have demonstrated reflex pathways between the gall bladder and the heart. Pain of acute coronary occlusion is often confused with pain produced by gall stones. Pain, fever, vomiting and leucocytosis are commonly met with in both conditions. But past history of indigestion is in favour of



cholecystitis. Babcock believes that inhibition of the heart can be caused by stimulation of the filaments of the vagus, arising from the walls of the gall bladder. The jaundice produced by gall bladder disease may secondarily affect the cardiac mechanism. Systolic apical murmurs have been reported by some observers appearing during pain from gall bladder focus. According to Laird, thrombosis of the coronary arteries occurred in 12% of cholecystitis cases. Cholecystectomy cured 78% of cases with gall bladder symptoms.

Taking all the above facts into consideration, it can be proved that nervous reflex—disturbance of the function of the vagus—giving rise to stasis of the bile flow due to disturbed duodenal reflex, combined with infection is the potent factor in the etiology of the pathological condition of the gall bladder. Disturbance of cholesterol metabolism and congenital anatomical abnormalities may be additional factors.

## BURNS

by MUNAWAR ALI.

(Concluded from previous issue.)

### EARLY PLASTIC TREATMENT OF THERMAL BURN

Burns could not be considered as healed until the granulating surfaces are epithelialised and the treatment could not be considered as over till complications like contractures and deformities have been corrected by plastic surgery.

*Care of granulating surfaces of thermal burn:* A patient running temperature, suffering from toxic and septic absorptions, having hypoproteinaemia, looking pale and anaemic, cannot be expected to have a granulating surface fit for grafting.

For successfully converting granulating surfaces of burns into a properly healed surface, it is imperative to pay attention to the general care of the patient. All attempts will prove futile if the soil is not fertile enough to take the graft.

To improve the general condition of the patient an adequate and well-balanced diet is essential. The daily protein requirements of such a patient is estimated to be as high as 200 to 400 grams per day. The expense and the poor appetite of such a patient have been very difficult problems. I have been successful in solving this in a small way by providing these patients with palatable, easily digestible and assimilable soup prepared by mixing serum obtained from the slaughter house blood with boiling tomato juice. In patients receiving this soup blood protein levels rose surprisingly quickly. It also helped in curing their anaemias to some extent. A haemoglobin level of about 75 per cent is essential for successful grafting. This may require repeated small blood transfusions. The problem of anaemia of thermal burn requires proper recognition and care from the early stages of burn therapy. If burn

cases are provided liberally with Vitamin C; the reparative process will be rapid.

While dealing with the thermal granulating surfaces plaster splints are used to retain the normal position. They do not prevent contractures; if applied after forcible stretching, the further damage thus created helps to lay down more scar tissue which eventually favours more contractures and deformities. The only way to prevent is by early skin grafting.

For practical purposes any burn ulcer of over 4 weeks' duration with a diameter of 2 inches or more requires skin grafting.

Grafts are taken from the patient's own skin. On rare occasions I use homogenous grafts in cases where in view of the general precarious condition of the patient it was considered advisable to convert a large raw surface into a healed surface and thus contribute to the early well-being of the patient. These homo-grafts from other individuals often take successfully but are destroyed by the recipient's body in the course of about 2 or 3 months. By the time this occurs the patient's condition will be improved sufficiently enough and he will be fit to undergo proper plastic repair from autogenous grafts. It is interesting to mention here that in our institution in some cases temporary covering of raw surfaces was obtained by using easily available homo-grafts from preputial skins of circumcised boys.

I have practically given up using small deep needle grafts (Reverdin's graft, Davis' graft, Pinch graft—this traumatic and damaging method was practised at one time and is now condemned), because when this

method is used the end result of both recipient and donor area is like crocodile skin—ugly and distasteful indeed.

In dealing with rare granulating surfaces specially in a patient who has had a stormy period of toxæmia and infection and in whom rapid and early healing is essential from the point of view of the patient's general condition and where in spite of the adoption of usual procedures some septic discharge persists, I have used small pieces cut from a sheet of split graft and embedded them under the granulating surface, hidden from the naked eye, covered with vaseline tulle and saline soaked gauze pads—the last-mentioned being changed daily. From these embedded grafts whitish islets of epithelium grow and gradually spread over the raw surface and epithelialise the burn area.

*Preparation of the granulating surface :* If surface swab under high power shows not more than 2 to 3 organisms per field such a surface is bacteriologically considered fit for grafting. However the suitable surface for grafting is more adequately judged by its clinical appearance. With some experience this can be well relied upon. The granulations should be healthy, clean and of good colour. Neither the granulations nor the surrounding area should be oedematous. In case of oedema attention should be paid to deal with hypoproteinaemia. Granulations should be on the same level as the surrounding skin. Antiseptics and greasy dressings are abandoned at least 24 hours prior to skin grafting. Skin grafts do not take well on greasy surfaces. During this pre-operative period saline soaks are used.

Granulations over 12 weeks are shaved off with a razor before grafting. Hot saline compress and firm bandage are applied. To avoid carrying sepsis gloves are changed before going over to the donor site for grafts.

*Donor Site :* It is selected remote from the raw surface. This is necessary to prevent infection of the donor site from the burn wound. Areas considered suitable for future pedicle grafts are left over. The convex surface of the thigh is ideal for the razor graft. Concave and irregular surfaces can also be used if Padget dermatome is employed.

The area from where the graft is taken is temporarily outlined with a fountain pen. Tincture of Iodine is applied. Half to one per cent Novocaine solution, without Adrenaline, is used for infiltration anaesthesia. All needle punctures start on the outline and these puncture marks serve as guides to cut grafts within these limits.

Intermediate split skin grafts of the Blair type are preferred, because of the small amount of scarring that occurs underneath these grafts and for their good appearance and lack of pigmentation and their ability to bear pressure moderately. Superficial epidermic grafts of Ollier-Theirsch variety are not used nowadays because they do not prevent sub-epithelial scarring, often show pigmentation, although they require less attention and the take is successful on even less cleaner surfaces.

For cutting split grafts the skin is held tight between two pieces cut from each end of a coathanger. With a very sharp razor the grafts are cut towards the operator, with flexed and fixed elbow and moving shoulder. These grafts are temporarily transferred to a tray containing warm normal saline.

After the removal of such grafts the donor surface should be a field of multiple minute bleeding points. The site should heal without scarring and be available for further use for taking grafts in about 4 to 6 weeks' time.

The donor site is dressed, with cod liver oil gauze, and a few layers of vaseline

gauze, covered in turn with a few more layers of dry gauze, thin cotton padding, and the whole is fastened with elastoplast. This dressing is removed between 11 and 14 days by which time the surface is probably healed.

*Grafting the Burn:* Before applying grafts on to the recipient area, they are fenestrated with sharp pointed scissors, nicks one inch apart, for the exit of exudate, should any occur. They are transferred with the aid of a shovel and applied with the aid of two dissecting forceps. No air, serous discharge, or fine blood clots are left underneath the graft. Grafts may be anchored to the edges with fine cotton stitches avoiding catgut as the latter excites tissue reaction. In the case of shaved granulation surfaces a few stitches across the graft as well are essential.

Thin and even frosting with penicillin of burn surfaces before laying the graft and parenteral administration of penicillin have decreased the number of failures specially those due to infection.

Dressing of the grafted area is a very important step indeed, requiring great skill and meticulous care on the part of the operator. This is best not left to juniors. A simple yet most useful first covering is perforated cellophane paper or perforated oiled silk. Over this is laid cod liver oil gauze, a few layers of vaseline gauze, a layer of cotton wool and finally sterilised mechanic's waste. In place of plain cotton, in cases where some discharge is expected, it is preferable to apply cotton soaked in acriflavine and paraffin. Dressing is held by firm elastic bandaging. Slipping of the dressing is prevented by adhesive elastoplast applied so as to anchor the dressing to

the surrounding skin. Where movement is liable to interfere plaster slab splintage is used for adequate immobilisation.

On the third day I prefer to open the dressing only down to the vaseline layer for inspection. If dry, superficial dressing is changed; if there is any discharge complete change is done, taking care that there is no pulling off, or disturbance, to the graft in the slightest degree. I do not soak the dressing before changing.

Rechanging is done as infrequently as is feasible, depending upon the amount of discharge.

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## PLASTIC REPAIR OF THE BURN CONTRACTURES AND DEFORMITIES

There are not a few patients who no doubt have survived the accident of burns, but wish they were among the fatalities, because they have been left with ugly scars, unsightly contractures and deformities, and in many instances with the resulting crippling disabilities. Such gross deformities which more or less cripple the individual, are so commonly met with in this country that they are not only an important medical problem but a social and economic problem too. What a valuable service it is to convert these individuals into useful citizens!

There are other instances where the condition is not so bad. Wounds of the deep burn might have healed with dense scars only to break down after some time due to occupational strain, ordinary trauma, or circulatory disturbances and persist for years as chronic ulcers in the centre of large healed scars. Such a patient loses body fluids, proteins, and blood over a number of years and becomes debilitated and anaemic, and runs the risk of malignant change not infrequently, with its disastrous effect to health and later to life.

It is of vital importance to appreciate that no burn case can be considered cured until complete and permanent restoration of normal physiological functions of the areas of the body involved in the accident are obtained.

In correcting these contractures and deformities it is worthwhile keeping in mind that when healed scar tissue contracts, it produces primary contractures. As time passes on, underlying structures—fasciae, tendons and even muscles, vessels and nerves, and later capsules of the joint become contracted secondarily, and lead to deformities with fixation of the joints.

It is sometimes not possible to assess the exact nature of the involvement until the dissection proceeds to the depth. Excision of the scar tissue is performed till good, soft and vascular tissue appears. In the deeper

dissection particularly one has to be very careful in doing no further damage to the already damaged area. Deformities are corrected with necessary surgical procedure slowly and patiently. This sometimes may require many operative sittings. Forcible correction might lead to regrettable results due to impairment of vascular supply, and consequent sloughing and death of an already traumatized tissue.

As in all other plastic repairs efforts are made to preserve and utilise all the locally available tissue by correct planning and proper execution.

Most of the resulting raw surfaces can be covered with split skin graft with good functional and cosmetic results. However, I prefer full thickness skin through pedicled flaps in situations like; the dorsum of the knee and ankle joints, heel and most of the palmar surfaces and dorsum of the hand, occasionally in front and below the shoulder joint and in front of the elbow, because in these regions they stand the occupational trauma and strain better. The only draw-back is that they require multiple operations and longer surgical care.

Free full thickness grafts are only used to cover small fresh raw surfaces in regions where otherwise pedicled flaps would have been required.

*Regional Repair:* If any of the patients brought for late plastic repair of burn has any raw surface left over, it is covered with Theirsch graft and allowed to heal before definitive treatment is started. This provides a clean surface free from infection for the plastic operation.

*Hand:* In my experience when a great part of palmar skin is lost, and the dissection for correction of the deformities has gone deep enough, and the tendons have been lengthened, abdominal skin through a pedicled flap, though a little laborious, provides the ideal covering. Subcutaneous fat gives a good covering to the exposed ten-



Fig. 8-a

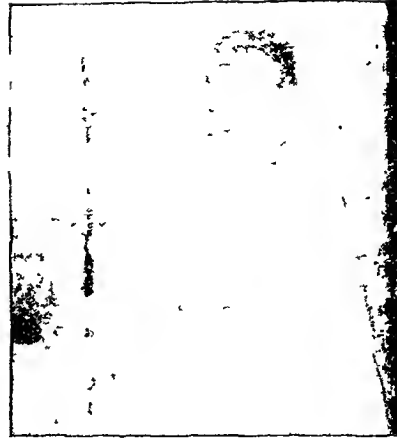


Fig. 8-b



Fig 8-c



Fig. 8-d

Fig. 8-a Shows deformity of the right hand due to burn when the patient was a baby. Fig. 8-b Abdominal pedicle graft transplanted to the wrist. Fig. 8-c further correction of deformity and spreading of the graft over the palm and finger. Fig. 8-d End result with a hand of good functional value and appearance.

dons and something like a new synovial sheath soon forms underneath this skin.

Fig. 8-a: On admission this little boy had a peculiar flexion deformity of the fingers and thumb. The thumb was completely folded and embedded in front of the wrist in a mass of scar tissue. The index finger was straight and immobile, middle and ring fingers badly contracted, and the little finger rigid and adducted to a right angle. This boy's hand was severely burned when only a baby, a few months old.

In many stages, by very careful excision of the scar tissue preserving all the structures, by elongation of tendons, by vessels and nerves being allowed to stretch, by restoring some of the inter-phalangeal joints by interposing tissues between bones, the thumb and fingers were gradually straightened.

Fig. 8-b: Abdominal pedicle was transplanted over the wrist area.

Fig. 8-c: Further release of the thumb and fingers, and graft spread over palmar and digital areas.

Fig. 8-d: Finally a hand with satisfactory function and good appearance was obtained.

Fig. 9-a: Shows a boy who had, a year ago, deep burns of the palmar side of the right hand, which had resulted in excessive scarring and contractures of the fingers and adduction deformity of the thumb. He was discharged from service as permanently unfit.

The scar was dissected layer by layer, thumb partly released, fingers straightened and passed through a tunnel of skin in the thigh. After the graft had taken, the hand was released and the webbing of the fingers corrected.

At the final sitting I make it a point to excise from underneath the newly grafted skin subcutaneous fat only along the side to give the finger its rounded contour, and leave the central strip of fat in front of the flexor tendons.

Fig. 9-b: Shows the end result after a few months with function completely restored, the grafted skin having adapted itself indistinguishably from natural palmar skin.

Fig. 10-a: A girl with severe scarring and contracture deformity of index and ring finger of right hand. After a difficult excision of keloid carefully performed it was embedded in the thigh with fingers spread apart.



Fig. 9-a



Fig. 9-b

Fig. 9-a Contracture deformity of the fingers corrected, fingers and the forepart of the palm embedded in the thigh Fig. 9-b Satisfactory end result.



Fig. 10-a



Fig. 10-b

Fig. 10-a Contracture deformity of the fingers corrected and fingers embedded in the thigh. Fingers are kept wide apart. Fig. 10-b Shows a satisfactory result. The grafted skin has started showing signs of adaptability.



Fig. 11-a

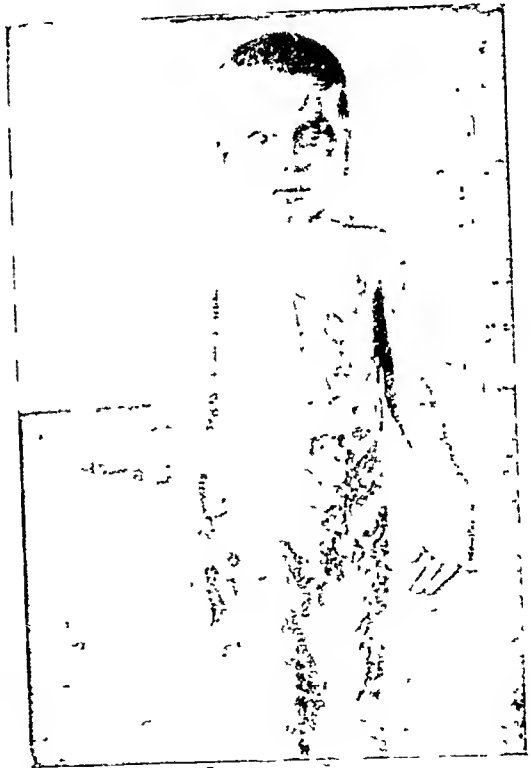


Fig. 11-b

Fig. 11-a A boy who has sustained very extensive deep burn. While still under treatment for granulating surface in order to prevent the contracture deformities of the hand it has been transplanted in the left thigh; graft has taken and is even showing signs of adaptability.

Fig. 11-b Same boy with a useful hand with slight contracture at the wrist for which treatment was refused





Fig. 12

Fig. 12-a

Fig. 12-b

Fig. 12 Shows the result of such a modified Y-plasty. (Perhaps more accurately to be called S-plasty.)  
 Figs. 12 a & b Represent diagrammatically wavy incisions for the correction of the arm-trunk adhesions.



Fig. 13-a

Fig. 13-a Shows a dense adhesion.



Fig. 13-b

Fig. 13-b Scapular and pectoral flaps have been used under the axilla for correcting adhesion.

Fig. 10-b: The same girl six weeks after with fair cosmetic and functional result.

Fig. 11-a: Shows a little boy with very extensive burn of mixed type, who had passed through a critical period of shock, toxæmia and infection. In this case I had violated the usual principles of plastic repair. Having guessed, as I later found myself to be correct, that when the deep burn wound healed completely by scarring, the mother will not permit me to repair the hand, as she had already refused simple grafting, I embedded the palm and base of the fingers of the left hand in a tunnel of the skin of the thigh—not far from the unhealed septic burn area.

Fig. 11-b: Shows the boy with a completely good palm and fingers. Slight abduction deformity due to scarring which could not be corrected as permission was not forthcoming.

*Axilla, Trunk and Arms:* The commonest deformities met with in this region is the arm united to the trunk by means of a web or dense scar tissue with or without sinuses leading to axilla. The web condition is often quite easily amenable to single or double ordinary or reversed Z-plasty, with the utilisation and suture of anterior pectoral and posterior scapular flaps.

In case there is considerable scar tissue wavy incisions and multiple short flap repair is sound in principle and often sur-

prisingly successful. In this way sloughing of the sharp pointed ends of the flaps of Z-plasty is avoided.

Fig. 12: Represents the end result of such a repair with complete restoration of the movements of the shoulder joint.

In case of dense adhesion in this region, (Fig. 13-a) I prefer thick scapular and pectoral flaps to cover the raw, uneven surface of the axilla after dissection and correction of the deformity. The remaining rough and uneven raw surfaces are allowed to smoothen out with new healthy granulation tissue before split grafts are applied.

Fig. 13-b: Shows pedicled flaps having taken and united under the axilla and the raw surface smooth and ready for split grafting.

*Cubital and Popliteal Areas and the Leg:* In the antecubital fossa occasional web like scar can easily be corrected by Z-plasty. Others may require thick grafts. However, in cases where scarring is deep I prefer pedicled graft for good function.

In the popliteal fossa to meet the demand of the strain of squatting I only use pedicled flap skin.

Fig. 14-a: Shows a chronic burn ulcer in the middle of a fibrous scar that has resulted in ankylosis of the right knee. This ulcer had persisted over a number of years, and probably would never have healed spontaneously.



Fig. 14-a



Fig. 14-b

Fig. 14-a. Shows the ankylosed right knee with scarring and ulceration.

Fig. 14-b. Left knee ankylosed with excessive scarring and contracture deformity.

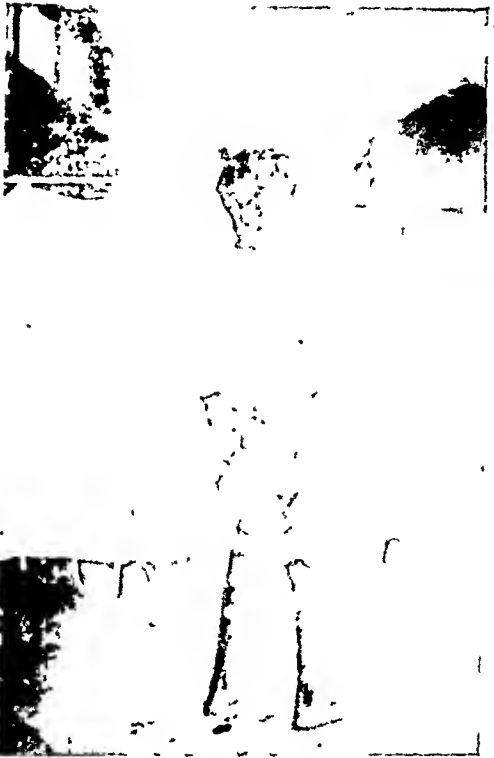


Fig. 14-c

14-c, Shows the end result after pedicle and split graft repair.

Fig. 14-b: The left leg was in a worse condition of ankylosis at the knee as a result of contractures of deep structures and a massive scar tissue. As a result of this deformity the patient had taken to begging. With great difficulty she was persuaded to undergo operative repair. While excision of scar and ulcer on the right side was possible in one stage, correction of the deformity on the left side was only possible in three laborious operative sittings, requiring excision of the scar, fasciotomy, tenotomies in stages, lengthening of contracted vessels, neurolysis, and finally capsulotomy by criss-cross incisions and stretching. Whole thickness skin from abdominal pedicled flap caterpillared to the wrist were grafted on the back of the knee and the remaining area was grafted with split graft. Nearly six months after, having remained a cripple for some years the patient was able to stand and walk. I sincerely hope she has kept up her promise and changed from begging to some useful occupation in the village.



Fig. 15-a

Fig. 15-a Shows a massive abdominal pedicle grafted to the healthy leg.

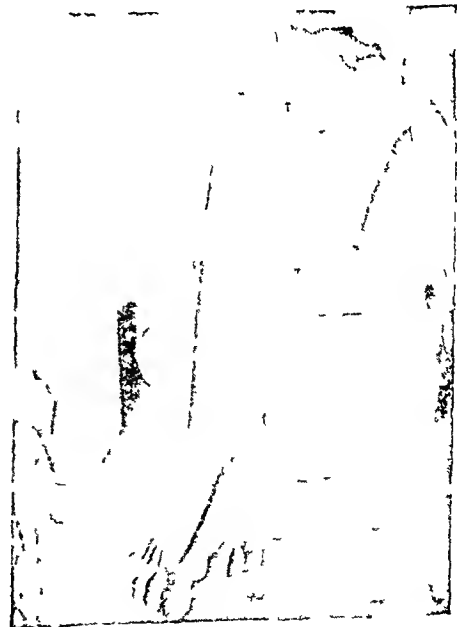


Fig. 15-b

Fig. 15-b After correction of the deformity pedicle is grafted over the dorsum of the left foot

For bare-footed people and farmers to stand the strain of occupational trauma I prefer pedicled flap in front of the ankle and lower leg.

Fig. 15-a: Shows a healed infected burn on the dorsum of the left foot and leg with severe contracture and dense scar in which the second, third, fourth and fifth toes were involved and partially buried. Excessive keloid formation and piling up of keratin were present. The foot was bound up in full dorsiflexion without any movements at the ankle. The patient could with great difficulty walk short hops over the left heel. After some years he came under my care, having been refused marriage until he was cured, fit and respectable looking.

A massive long abdominal pedicle has been transplanted to the right leg.

Fig. 15-b: After excision of keloid and scar tissue, and lengthening of tendons, abdominal skin has been grafted. At a later stage remaining scar was excised and the pedicle completely flattened out. Unfortunately for me the patient was so happy about his appearance and so anxious for his marriage that he left without saying goodbye to me, and robbed me of the pleasure of the final clinical photograph.

Burn ulcer scars on the heel are so liable to malignancy that an early excision is imperative. Whole thickness pedicled flap with as much amount of fat as available serves the purpose—but unfortunately not quite satisfactorily for weight bearing purposes among the barefooted farmers and villagers.

*Head and Neck:* On the scalp raw surfaces can satisfactorily be covered by split grafts. When the area is denuded of pericranium split grafts do not take and therefore I cover it by swinging a pedicled flap from adjacent scalp area, and the new defect thus created is covered with split grafts.

On the face thick skin grafts take quickly and are satisfactory. Near about the eyelids I prefer full thickness free skin grafts.

Occasionally pedicled grafts are required. Repair on the face requires special attention in planning and execution.

On the neck Z-plasty sometimes is partially or completely satisfactory; the remaining area is grafted with deep split graft and rarely by pectoral pedicled flap.

*Genital and Perineal Region:* When the skin of the penis is lost or damaged it can be suitably repaired by baring the penis and embedding it through a scrotal tunnel.

When the damage is deeper I use bilateral abdominal pedicles for the repair. Here I would like to digress and refer to Fig. 16



Fig. 16

Fig. 16. Shows an abdominal pedicle grafted at the ankle standing erect.

where the abdominal pedicle is standing erect on the dorsum of the foot. The accidental happening has helped me in repair of the penis in such cases. Accidental use of thick catgut suture for converting the flap into a tube gave rise to some tissue reaction and resulted in a fibrous scar which also penetrated somewhat to the depth of the tube and made it stiff. I now use purposely thick catgut subcuticularly to unite the right and left abdominal pedicles on the ventral and dorsal aspects of the penis and complete the repair by cuticular fine cotton stitches.



Fig. 17

Fig. 17. Shows the use of the single abdominal pedicle for clothing the penis.

In case of deep but uniform involvement of penile skin a temporary perineal urethrotomy is performed, and the penis is clothed in a single abdominal pedicle as shown in Fig. 17.

Abdominal pedicled flaps can be used with advantage in the repair of the female genitalia.

A preliminary spur colostomy is essential prior to the repair at the anal region. Pedicled flaps from gluteal region are utilised in this situation.

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## DISCUSSION

A. de Sa described 45 cases of all degrees of burns treated at the Bai Jerbai Wadia Hospital for the three years 1944-1947.

All these cases were treated by a uniform method—a minimum debridement and cleansing with normal saline without an anaesthetic, and a subsequent compression dressing with 5% sulfa-thiazole ointment, after the method of Koch and Allen. The over all mortality in this group of cases was 14%—the large majority of deaths in this group occurring in patients who had burns involving over 20% of the body surface. The problem of sedation in these infants was an important one. Morphine was generally inadmissible in children of the age groups encountered. Intramuscular injections of paraldehyde had been found useful, but this form of therapy was contra-indicated in burns involving the chest, from the risk of pulmonary complications supervening.

Among the untoward complications that developed, were diarrhoea (11.1% of cases) which responded to the customary astringent remedies, and convulsions, which were of grave prognostic import. Of the three cases that developed convulsions, two died.

N. F. Saher : The opener has rightly pointed out the risk of repeated subcutaneous injections of morphine to the burnt subject. The intravenous use of morphine for relief of pain is not as extensively practised as it deserves. For the average patient a sixth of a grain of morphine is dissolved in two c.c. of distilled water and injected reasonably slowly into a vein; too rapid an administration may lead to unpleasant side effects like nausea, giddiness and sickness. Apart from being a more certain method of exhibiting morphine, the intravenous route is much quicker in affording relief from pain. Given subcutaneously morphine requires 60 to 90 minutes for production of maximum depressant action; this period is reduced to 10 to 20 minutes by employing the intravenous route. In exhibiting morphine and anaesthetic agents it is imperative to bear in mind that the burnt subject is an ill patient; a little goes a long way with him.

Frequently the common sites for intravenous medication are involved by the burns. In such cases the sternal route of transfusion proves of life saving value. With a special short, thick trocar and cannula either the centre of the manubrium or the body the sternum is pierced so that the anterior plate of the sternum is traversed; the trocar is withdrawn, leaving the cannula firmly held by bone. A syringe is now attached to the cannula and sternal marrow is aspirated. The transfusion tube is now attached to the cannula. Since the cannula is gripped by bone the risk of accidental displacement is reduced.

R. Maladevan : While tannic acid treatment undoubtedly saved many lives, it was found that it

had toxic effect on the liver, which accounted for some of the deaths. Silver nitrate solutions in combination with various aniline dyes had a trial, and were found to be safer from the point of view of liver damage. Still the treatment was not all that one could wish. Simplified methods of treatment are coming into vogue and are credited with more favourable results.

1. General anaesthesia in some form is usually administered for debridement of the burnt areas. It is now realised that this is better avoided, as the anaesthetic agents were found to be responsible for some of the deaths. There is reason to believe that cases of burns have relatively little pain after the first half hour, morphia in adequate doses and repeated as found necessary is sufficient to relieve the pain.

2. All forms of cleansing excepting the removal of gross dirt may be omitted. Even for this, the area should not be scrubbed with a brush, but only cleaned up with soap and water using soft cotton swabs. In the well known "Cocoanut grove disaster" neither cleansing nor debridement of the burnt area was done. (Cope, 1943.)

3. As a part of first aid treatment, the burnt area is covered with sterile towels. Then the surgeon scrubs up with all the scrupulous care as for a major operation; donning sterile overalls, gloves, face mask and cap. Then and then only further attention to the burnt area begins. This is considered by many as a very important necessity to prevent access of infection from external sources. One of the previous speakers said that infection in burns is due to the already existing organisms in the skin and not due to the infection introduced from without. This I am afraid is dangerous teaching. It is the opinion of almost all that the precautions mentioned, viz., the surgeon scrubbing up as for a major operation is a vital necessity.

4. The burnt area is dressed in one of several ways varying according to the views of the individual surgeon and the fad in vogue at different times. A good method seems to be to dust the area with a powder, consisting of sulphanilamide and light magnesium oxide to which is added calcium penicillin so as to give a strength of 1000 units per gram (Wakeley, 1945) or to apply a cream made with soft paraffin and lanette wax to which is added penicillin solution, so as to give a strength of 1000 units per gram (Wakeley, 1945). Penicillin-sulphamezathine powder has been used with gratifying results. As a first aid in small burns or when patients cannot be removed to a hospital, better than application of tannic acid jelly, is the following:—

Gentian violet	1%
Brilliant green	0.1%
Euflavine	0.1%

to which 5% sulphadiazine is added and applied in the form of a jelly (Wakeley, 1946).

5. Shock in burns is due to escape of plasma from the circulation into the burnt areas. To combat this loss, plasma transfusion has to be instituted as early as possible. Oxygen inhalation is of great help. If plasma is not readily available, fluid loss may be replaced by one or other well known methods. The use of continuous intra-gastric drip feeds and particularly continuous intra-gastric isotonic saline may be of help and of easy adaptability in out of the way places, where more elaborate methods may not be feasible. In addition, mechanical measures to prevent escape of plasma into the burnt areas by the application of elastic bandages over the dressings (so called occlusive method) may be adopted. We have been experiencing difficulty in getting requisite elastic bandages. Moreover, it is a costly method. As an alternative, layers of aqueous flavine gauze soaked in vaseline or liquid paraffin are laid over the burns, liberally sprinkling penicillin sulphamethazine powder between the layers. Firm pressure over these is obtained by moulding plaster bandages to the area. The dressings are not changed until ten to fourteen days after the burn. This is least disturbing and therefore comfortable to the patient. The method gives gratifying results. The nutrition of the patient must be kept up by food rich in proteins, carbohydrates and vitamins, particularly vitamin C. These patients tend to become anaemic and this must be controlled by massive doses of iron and blood transfusions.

Chronic sepsis and contractures should be prevented by early skin grafting. Skin grafts do take even in the presence of mild sepsis. In all cases of 3rd degree burns, early skin grafting, preferably within 6 weeks, is a very important step. Some advise immediate skin grafting in complete skin loss burns.

Chronic infections resistant, to even sulphanilamide and penicillin are sometimes met with. Such infections are mainly due to *B. Coli*, *B. Proteus* and *B. Pyocyaneus*. These infections are best treated by local application of urea formic iodide (U.F.I.) (Wakeley, 1945, 1946). It is a white, water-soluble, non-toxic, non-irritant powder and can be applied locally in powder form or in solution. It is effective not only in the above infections but also acts on both aerobic and anaerobic organisms. The use of U.F.I. powder allows skin grafting to be performed right up to the anal margin even in burns of the gluteal and anal margin. (Wakeley, 1945.)

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H. Hyderali Khan: Burns of the whole body have been considered as fatal. The survival of the following two cases will demonstrate the possi-

bility of saving life inspite of burns of the whole surface of the body. The moral is that one should never despair.

1. *Kannala Balaiah*. This miner had burns of the complete body from the scalp to the sole of the foot. He was given stimulant, kept under an electric cradle, and saline administered. After a few days he developed considerable sepsis particularly of the abdominal wall. This was counteracted by penicillin and the patient got gradually better and was discharged from the Hospital after 45 days. Except that his ears were crumpled he was none the worse for his burns.

2. *Bansraj Kevot*. This coalcutter was admitted to Hospital for burns of the whole surface of the body. He was given saline, coramine and kept in the electric cradle. After a few days he developed sepsis. This was counteracted with sulphanilamide and Penicillin. He was discharged after 65 days. Except that he could not use his left fore-arm on account of the formation of scar tissue he was normal.

S. B. Gadgil: In the paper read on 'Burns', great stress has naturally been placed on paying attention to the nutrition of the patient. The patient loses weight due to loss not only of burnt tissues but also due to loss of plasma proteins brought to the burnt tissues by osmosis and lost in oedema and discharge. The method given to determine this loss of protein is too elaborate in my opinion. Determination of the weight of such a patient repeatedly while under treatment and the knowledge that he is passing sufficient amount of urine in 24 hours should be quite enough to guide us that the patient is or is not having sufficient nourishment while under our treatment and alteration of diet made if necessary.

R. N. Dixit: (1) Plasma transfusion was invaluable in all cases of severe burns. The cost of plasma was however prohibitive. A bottle of dried plasma giving 250 c.c. of plasma for transfusion purposes costs anything between Rs. 50 to Rs. 60. The speaker drew the attention of the Conference to a recent article appearing in the "Lancet", by the Director of Physiological Department of the Palacky University of Czechoslovakia, where denatured calf-plasma (calf-plasma from which foreign proteins likely to give rise to severe reactions were removed by precipitation with formaldehyde) was tried out successfully. He was of opinion that the Haffkine institute should investigate into the use of animal plasma as a substitute for human plasma. If this is found satisfactory, it would be a great boon to a poor country like India, where there was also a great paucity of donors.

(2) Debridement in some cases of burns was almost imperative. Thus on several occasions burns cases are brought to the Hospital after application of all types of dirty and highly infective materials, like cow-dung.

# A STUDY OF THE LONGITUDINAL ARCH OF THE FOOT

by A. K. BASU.

(Concluded from the previous issue)

## The influence of postural tone on the longitudinal arch of the foot

A series of investigations were made to determine how far the postural tone of the long muscles was responsible for the maintenance of the arch. To this tonus has been ascribed the important function of producing and maintaining the longitudinal arch by Bankart, Wiles, Keith, Wiltz, Kaplan, Crandon, Cotton and others, while the same has been denied by Whitman, Lake, Morton, R. L. Jones and others. According to Lake, the purpose of postural tone is never to withstand dead weight, but to perform the delicate action of balancing one bone upon another such as the femur on the tibia and the leg on the foot. Morton (1935) was of the same opinion. From his staticometer study, he determined that the ratio of weight distribution among the different metatarsals when a person is standing with his body weight on both feet is in the ratio of 2:1:1:1:1 and he ascribed to the evertor and invertor muscles of the foot the function of maintaining the leg in a vertical position above the astragaloid joint. R. L. Jones from his experimental study made the suggestion that the important—perhaps the chief—function—of the so-called invertor and evertor muscles is “to preserve a relative constancy in the ratio of weight distribution among the metatarsals of the foot compensating reflexly for the intrinsic and extrinsic factors which alter that ratio.”

What is postural tone? It is, according to Sherrington, a state of continuous contraction of certain skeletal muscles which are concerned with maintaining position or posture. The distribution and degree of this contraction among the various muscles of the body are related to the attitude adopted by the animal. The upright extended position of man in the animal kingdom suggests a preponderance of this tonus in the anti-gravity muscles—the physio-

logical extensors in the case of the limbs and the back muscles in the case of the trunk. This tonus is reflex in origin—the afferent impulses originate in the sense organs of the muscles themselves and to a lesser extent is re-inforced by impulses from the vestibular apparatus and the eyes. The reflex arc employed is wholly somatic, autonomic nerves are in no way involved (Wright). The exact anatomical centre for this reflex is not known but it has been seen in animal experiments that if the red nucleus and the rubrospinal tract remain intact, the posture remains normal; while sections below this nucleus and severing this tract, interfere with the normal posture in various ways by producing conditions of decerebrate rigidity, flexor spasm in the spinal animal etc., while section of the posterior nerve roots abolishes all muscle tone and produces complete flaccidity in the muscles concerned.

Some of the characteristics of postural tone with which we will be concerned may be mentioned here.

(1) The low degree of tension that the postural muscles develop amounting approximately to only  $\frac{1}{5}$  of the contractural force. This is evident from the low metabolism of the muscles concerned (oxygen consumption and carbon dioxide output) which is only 25% higher than completely paralysed muscle (Wright). Thus the quadriceps of cats develop 6 kgm. tension when acting tonically and 30 kgm. when contracting tetanically (Wright). “Such weak action seems rather unsuited for maintaining the whole weight of the body in the absence of any static support from the skeletal structures but is obviously ideal for maintaining posture where it implies the delicate balancing of one bone upon another.” (Lake)

(2) The relative unfatiguability of the posturing muscles. It has been found that



in producing postural tone the anterior horn cells discharge impulses at a low rate of 5 to 20 per second in contra-distinction to the tetanic contraction in which impulses are discharged at the rate of 100 per second. Such slow discharge of impulses produces individual twitch response of the different fibres of the muscles at different times so that they get periods of rest between each individual contraction—the whole producing a uniform tonic tension without fatigue.

If this unfatiguability of the tonus of the postural muscles responsible for the maintenance of the arch be true, it is evident that other factors remaining the same, falling of the arch and weakness of the foot would be no more common amongst people who bear stress on their feet for prolonged periods than amongst people whose feet get long

periods of rest. Such in fact is not the case. It is found (R. L. Jones—1941) that the flattening of the arch and foot strain are more common amongst people who have to do long periods of standing as waitresses, policemen, nurses, etc. It is less common amongst people who do a lot of walking or people who carry heavy weight on them (Porters). This led Jones to enunciate the hypothesis that is in apparent contradiction to the unfatiguable character of the postural muscles—that “distress of failure of the human longitudinal arch is co-related not with the absolute value of the stress on the arch but with the temporal duration of that stress.”

To test the influence of postural tonus on the longitudinal arches of the feet, certain conditions in which it is generally accepted that the tonus becomes diminished were

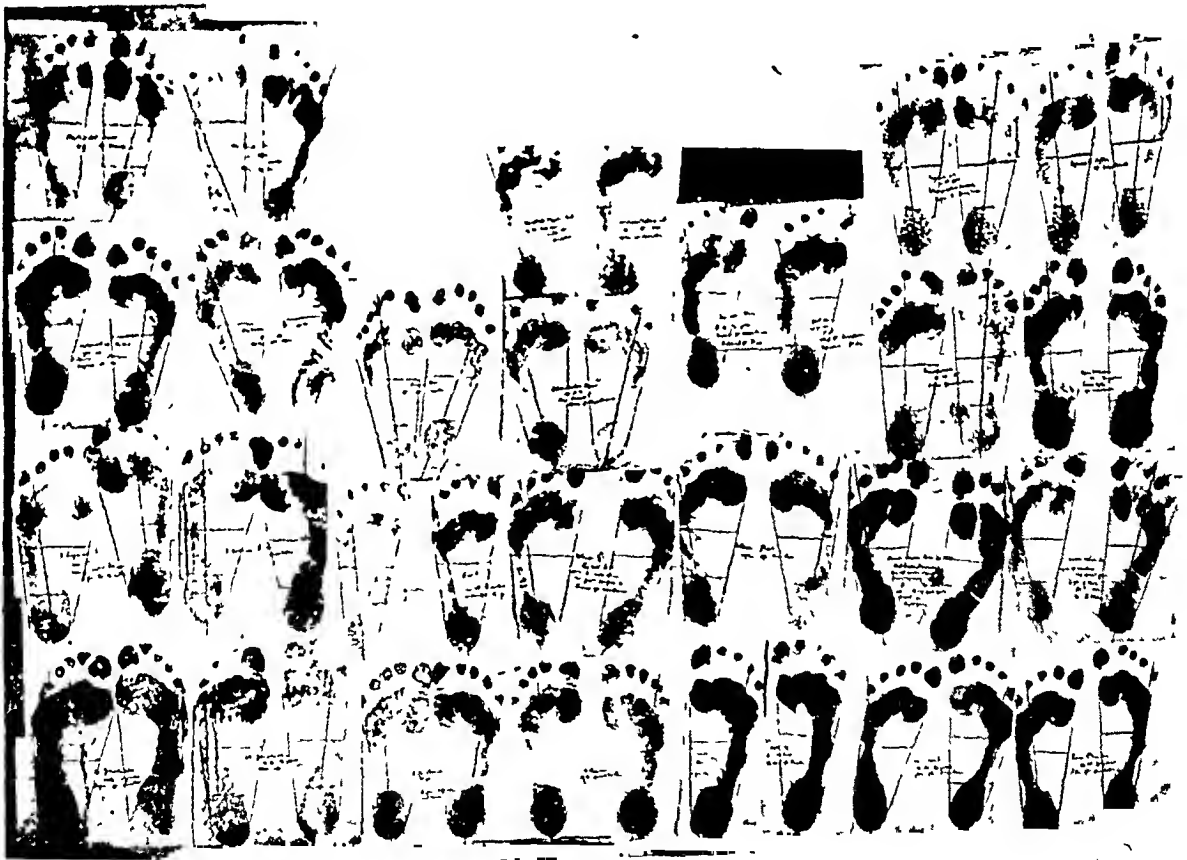


Fig. 11.

Foot-prints before and after spinal anaesthesia.

TABLE III

No.	Name	Age	Disease	Before Spinal Anaesthesia		After Anaesthesia	
				Arch Fraction	Degree of Abduction	Arch Fraction	Degree of Abduction
1.	Mitailal Shaw	21	Strangulated Hernia	Rt = .21 Lt = .19	Rt = 2D Lt = N	Rt = .28 Lt = .21	Rt = N Lt = 2D
2.	Raghunath	45	"	Rt = .32 Lt = .38	Rt = 3D Lt = 2D	Rt = .37 Lt = .30	Rt = 3D Lt = 2D
3.	Ram Charan	35	"	Rt = .18 Lt = .17	Rt = 3D Lt = 3D	Rt = .20 Lt = .23	Rt = 2D Lt = 3D
4.	A. K. Das	40	"	Rt = .15 Lt = .22	Rt = 1D Lt = 2D	Rt = .13 Lt = .25	Rt = 1D Lt = 1D
5.	S. C. Mitra	45	"	Rt = .28 Lt = .36	Rt = 2D Lt = 3D	Rt = .25 Lt = .31	Rt = 1D Lt = 1D
6.	M. M. De	35	"	Rt = .38 Lt = .35	Rt = 1D Lt = 1D	Rt = .34 Lt = .38	Rt = 1D Lt = 2D
7.	N. M. Ghosh	60	"	Rt = .35 Lt = .21	Rt = 1D Lt = 1D	Rt = .39 Lt = .18	Rt = 1D Lt = N
8.	Bhagaban Bera	40	"	Rt = .26 Lt = .33	Rt = 3D Lt = 1D	Rt = .24 Lt = .31	Rt = 2D Lt = 1D
9.	Bk. Jalaluddin	55	"	Rt = .42 Lt = .43	Rt = 1D Lt = 1D	Rt = .35 Lt = .41	Rt = 1D Lt = 1D
10.	Sampat Rao	35	Comp. Fr. R. Leg	Rt = .26 Lt = .26	Rt = 1D Lt = 1D	Rt = .26 Lt = .20	Rt = 1D Lt = 1D
11.	T. Chakravarty	30	Fr. Patella Right	Rt = .21 Lt = .17	Rt = 1D Lt = 1D	Rt = .15 Lt = .15	Rt = 1D Lt = 1D
12.	Bando	35	Comp. Fr. R. Leg	Rt = .24 Lt = .16	Rt = 2D Lt = 2D	Rt = .19 Lt = .19	Rt = 2D Lt = 3D
13.	K. K. Charian	39	Hydrocoele	Rt = .27 Lt = .20	Rt = 1D Lt = 1D	Rt = .32 Lt = .23	Rt = 1D Lt = 1D
14.	Shamlal	16	Comp. Fr. L. Leg	Rt = .42 Lt = .20	Rt = 1D Lt = 1D	Rt = .36 Lt = .23	Rt = 1D Lt = 1D
15.	Ram Chandra	21	Hydrocoele				

investigated. The foot prints of a large number of people while under these conditions were obtained and the average degree of weakness or otherwise as determined from these prints were compared with the average of apparently normal barefooted persons. Such conditions were:—(1) Patients while under the influence of spinal anaesthesia. (2) Patients suffering from complete paralysis of both inferior extremities due to any disease or to a lesion of the spinal cord. (3) Patients suffering from extensive inflammatory conditions around leg and foot. (4) Patients suffering from acute toxæmic conditions. (5) Female patients in late stages of labour or just after child-birth. (6) Foot prints obtained from recently amputated legs.

### Spinal Anaesthesia (Table III)

The foot prints of 15 patients before and about 10 minutes after the administration of spinal anaesthesia were obtained (Fig. 11). May & Baker's preparation—Dura-caine—hypobaric solution (S. G. 1002) was used in these cases.

About 3 c.c. was injected intrathecally. The patients were operated on for various conditions such as strangulated hernia, amputation of leg, compound fracture, rectal lesions, hydrocele etc. If the theory that the arch of the foot is maintained or at least partially supported by the postural tone of the muscles be true, spinal anaesthesia, since it abolishes this reflex tone by affecting the nerve roots, should have caused total or partial falling of this arch. That it did not do so is abundantly clear from the series of prints. It cannot be said that the rigidity of the arch was the result of restrictions of foot wear as most of these patients were from the labouring classes and very occasionally or rarely were accustomed to wear shoes. Comparison of the prints before and after anaesthesia revealed the following:—

	Before Anaesthesia	After Anaesthesia
Average arch fraction	.31	.26
1st degree of weakness	50%	50%
2nd degree of weakness	22%	18%
3rd degree of weakness	18%	15%
4th degree of weakness	Nil	Nil
Normal feet	6%	11%

TABLE IV

No.	Name	Age	Occupation	Lesion	Arch Fraction	Degree of Weakness
1.	Tuar	...	25	Labourer	Cerebral thrombosis c Hemiplegia.	Rt=Normal Lt=1D
2.	Argusha	...	25	Labourer	Spinal injury paraplegia.	Rt=.35 Lt=.30
3.	Abdul Hamid	...	35	Labourer	Transverse myelitis paraplegia.	Rt=.32 Lt=.45 Rt=2D Lt=3D
4.	Kasi Ram	...	20	Labourer	Spinal injury paraplegia.	Rt=.30 Lt=.42 Rt=Normal Lt=1D
5.	Jamin	...	40	Sweeper	Spinal injury paraplegia.	Rt=.43 Lt=.46 Rt=1D Lt=2D
6.	Ramani	...	35	Coolie	Spinal injury paraplegia.	Rt=.25 Lt=.30 Rt=2D Lt=1D
7.	S. Mondal	...	20	Labourer	Spinal injury paraplegia.	Rt=.30 Lt=.44 Rt=Normal Lt=1D
8.	Sadhu	...	40	Labourer	Spinal injury paraplegia.	Rt=.25 Lt=.30 Rt=2D Lt=1D
9.	D. L Ram	...	45	Coolie	Spinal injury paraplegia.	Rt=.38 Lt=.36 Rt=2D Lt=2D
10.	B. Ali	...	40	Labourer	Spinal injury paraplegia.	Rt=.43 Lt=.35 Rt=2D Lt=1D
11.	M. Bera	...	45	Coolie	Cervical paraplegia.	Rt=.24 Lt=.22 Rt=Normal Lt=2D
12.	Meghnad	...	35	Cultivator	Cervical paraplegia.	Rt=.20 Lt=.19 Rt=1D Lt=1D
13.	Jagaya	...	35	Cultivator	Cervical paraplegia.	Rt=.20 Lt=.19 Rt=1D Lt=2D
14.	N. Ghosh	...	30	Clerk	Compression fracture spine paraplegia.	Rt=.35 Lt=.24 Rt=Normal Lt=1D
15.	Thakur	...	32	Cook	Transverse myelitis paraplegia.	Rt=.45 Lt=.44 Rt=3D Lt=3D
16.	S. N. Banerjee	...	45	Lab. Asst.	Compression fracture spine paraplegia.	Rt=.34 Lt=.42 Rt=Normal Lt=1D
17.	A. Kader	...	22	Coolie	Compression fracture spine paraplegia.	Rt=.32 Lt=.24 Rt=2D Lt=2D
18.	S. N. Chakravarti	...	19	Student	Compression fracture spine paraplegia.	Rt=.35 Lt=.35 Rt=2D Lt=4D
19.	Priyalal	...	25	Coolie	Spinal injury with paraplegia.	Rt=.38 Lt=.38 Rt=2D Lt=2D
20.	B. Kahaman	...	26	Labourer	Compression fracture spine with paraplegia.	Rt=.40 Lt=.24 Rt=3D Lt=1D
					Rt=.34 Lt=.30 Rt=2D Lt=2D	

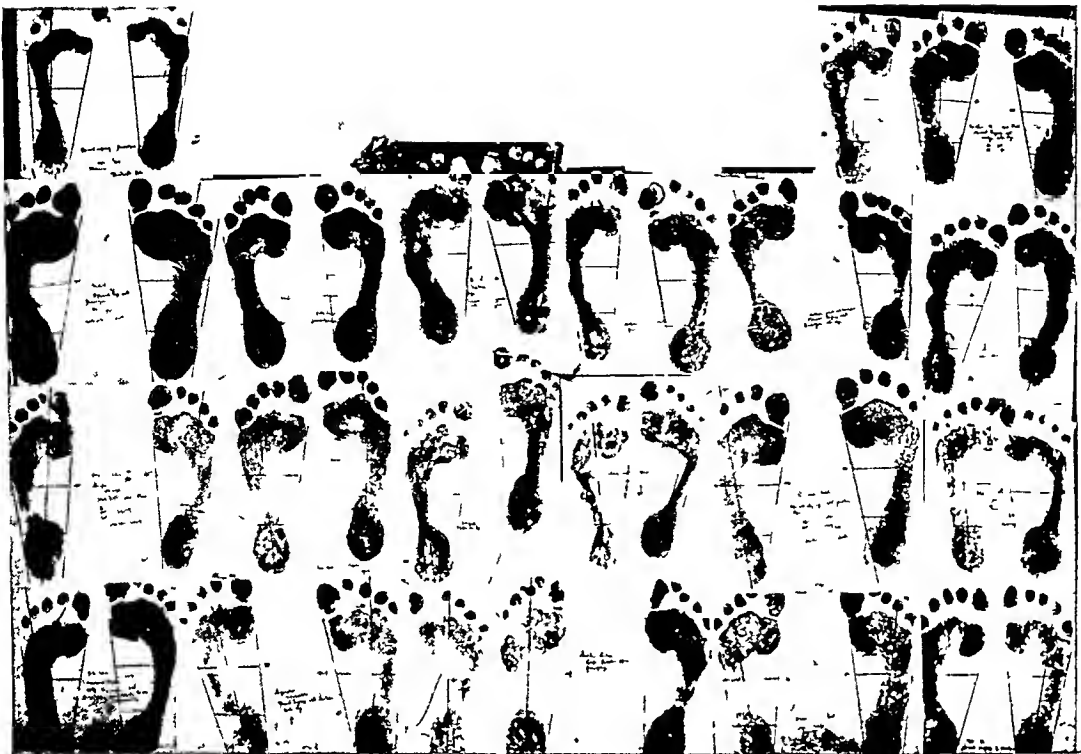


Fig. 12.  
Foot-prints of patients with paralysed lower extremities.

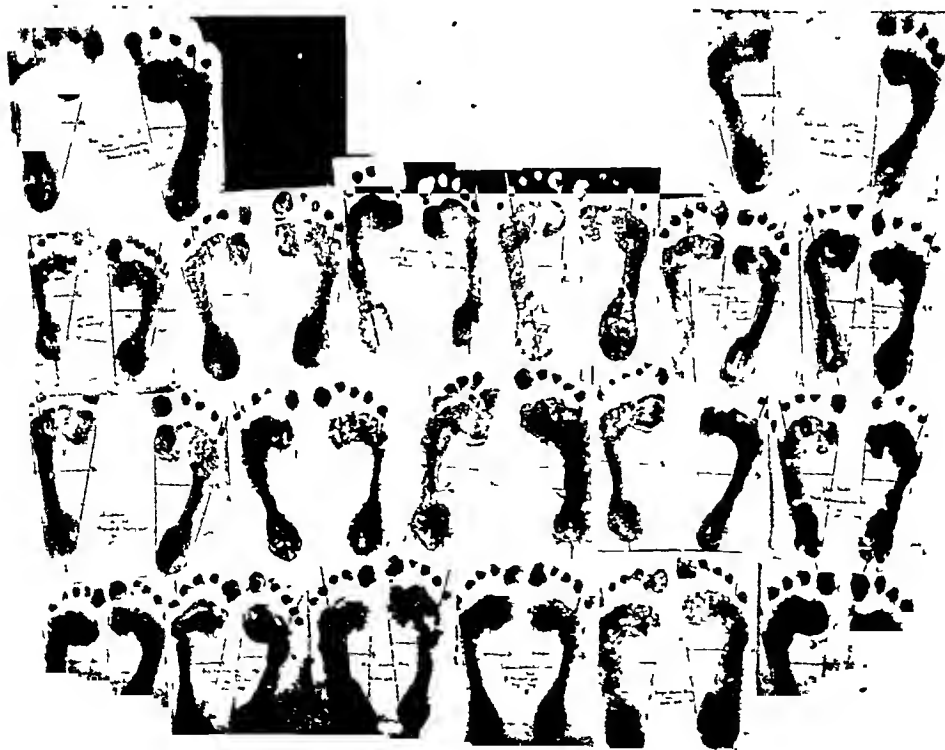


Fig. 13



Fig. 14.  
Foot-prints of patients with acute toxæmic conditions.



Foot-prints of pregna

after

TABLE-V

No.	Name	Age	Occupation	Disease	Arch Fraction	Degree of weakness
1.	Gopal	.. 11	Nil	Chr. Osteomyelitis. lt. tibia.	Rt=.23 Lt=.26	Rt=2D Lt=1D
2.	Jagabundhu	... 24	Shop Keeper	Pyarthrosis. rt. knee. oedema legs.	Rt=.40 Lt=.29	Rt=1D Lt=2D
3.	Bani Gopal	... 34	Shop Keeper	Compound septic fr. left leg.	Rt=.30 Lt=.34	Rt=1D Lt=Normal
4.	S. Dam	... 35	Labourer	Extensive cellulitis dorsum of left foot.	Rt=.19 Lt=.43	Rt=Normal Lt=Normal
5.	Raja Mia	.. 44	Rajmistry	Cellulitis left leg & foot.	Rt=.35 Lt=.29	Rt=1D Lt=1D
6.	Ramabatar	... 57	Bearer	Osteomyelitis rt. foot.	Rt=.39 Lt=.24	Rt=Normal Lt=1D
7.	Jamir	... 27	Coolie	Cellulitis left leg.	Rt=.29 Lt=.27	Rt=2D Lt=1D
8.	P. Mahato	... 30	Cart driver	Septic injury left knee & cellulitis.	Rt=.29 Lt=.27	Rt=2D Lt=1D
9.	S. L. Patra	... 40	Labourer	Cellulitis left leg.	Rt=.40 Lt=.54	Rt=1D Lt=1D
10.	Jasimuddin	... 30	Cultivator	Cellulitis foot leg & thigh rt.	Rt=.31 Lt=.32	Rt=1D Lt=1D
11.	Jiban Mandal	... 14	Coolie	Osteomyelitis rt. leg.	Rt=.31 Lt=.32	Rt=1D Lt=2D
12.	J. Narman	... 40	Electric Mistry	Old septic injury left leg with atrophy & contracture of muscles.	Rt=.33 Lt=.34	Rt=1D Lt=2D
13.	F. Mandal	... 40	Methar	Infected fr. rt. leg.	Rt=.29 Lt=.32	Rt=1D Lt=1D
14.	Sree Krishna	... 50	Coolie	Cellulitis left foot.	Rt=.30 Lt=.30	Rt=1D Lt=1D
15.	Sk. Panchu	... 30	Foreman ship	Infected fr. rt. leg.	Rt=.42 Lt=.26	Rt=Normal Lt=Normal
16.	Bahadur	... 23	Durwan	Osteomyelitis rt. hip with amyloid disease.	Rt=.37 Lt=.23	Rt=1D Lt=3D
17.	Navajiban	... 40	Coolie	Extensive cellulitis left leg.	Rt=.39 Lt=.40	Rt=1D Lt=1D
18.	B. N. Singh	... 24	Driver	Osteomyelitis rt. foot.	Rt=.29 Lt=.24	Rt=Normal Lt=1D
19.	Suleman	... 30	Coolie	Infected injury foot.	Rt=.27 Lt=.32	Rt=1D Lt=1D

TABLE VI

No.	Name	Age	Occupation	Disease	Arch Fraction	Degree of weakness
1.	S. Banerjee	...	17	Student	Enteric fever 16 days.	Rt=.36 Lt=.43 Rt=1D Lt=Normal
2.	Luxmi	...	12	Student	Enteric fever 40 days.	Rt=.37 Lt=.29 Rt=Normal Lt=Normal
3.	K. P. Sanyal	...	28	Clerk	Enteric fever 20 days.	Rt=.38 Lt=.37 Rt=1D Lt=2D
4.	Jagannath	...	16	Labourer	Enteric fever 16 days.	Rt=.21 Lt=.19 Rt=1D Lt=1D
5.	U. N. Das	...	26	Driver	Enteric fever 26 days.	Rt=.24 Lt=.11 Rt=Normal Lt=Normal
6.	Sankar	...	25	Cook	Enteric fever 20 days.	Rt=.38 Lt=.20 Rt=1D Lt=1D
7.	J. Ali	...	35	Labourer	Enteric fever 24 days.	Rt=.42 Lt=.41 Rt=Normal Lt=1D
8.	Bilasi	...	26	Nil	Pneumonia.	Rt=.25 Lt=.22 Rt=1D Lt=2D
9.	M. Omar	...	26	Bearer	Pneumonia.	Rt=.51 Lt=.38 Rt=1D Lt=1D
10.	B. Bagal	...	21	Cultivator	Pneumonia.	Rt=.44 Lt=.46 Rt=2D Lt=2D
11.	J. Das	...	40	Labourer	Pneumonia.	Rt=.44 Lt=.39 Rt=1D Lt=1D
12.	Pania	...	48	Nil	Pneumonia.	Rt=.26 Lt=.42 Rt=3D Lt=1D
13.	P. Paramanik	...	22	Barber	Pneumonia 10 days.	Rt=.35 Lt=.22 Rt=Normal Lt=Normal
14.	H. P. Sarkar	...	23	Cultivator	Fever 10 days.	Rt=.23 Lt=.26 Rt=1D Lt=1D
15.	G. Misir	...	43	Durwan	Fever 5 days.	Rt=.28 Lt=.32 Rt=3D Lt=2D
16.	P. Ghosh	...	26	Nil	Chr. malaria one year.	Rt=.28 Lt=.34 Rt=Normal Lt=1D
17.	Imam Sarif	...	60	Nil	Malaria with oedema legs extreme emaciation.	Rt=.35 Lt=.34 Rt=Normal Lt=1D
18.	J. Misry	...	35	Electric Mistry	Electric shock.	Rt=.44 Lt=.53 Rt=Normal Lt=Normal
19.	K. C. Ghosh	...	32	Clerk	Fever 1 month.	Rt=.22 Lt=.26 Rt=Normal Lt=Normal
20.	N. Bibi	...	28	Nil	Fever 1 month.	Rt=.46 Lt=.45 Rt=1D Lt=1D
21.	Sindhu B. Dasi	...	25	Nil	Nephritis with oedema legs.	Rt=.18 Lt=.24 Rt=1D Lt=Normal
22.	Ganesh	...	50	Nil	Ascites with oedema legs.	Rt=.39 Lt=.11 Rt=Normal Lt=Normal
23.	Janaki	...	26	Labourer	Congestive cardiac failure.	Rt=.41 Lt=.50 Rt=1D Lt=1D
24.	Makhan Lal	..	25	Labourer	Diabetes extreme emaciation.	Rt=.21 Lt=.26 Rt=1D Lt=2D
25.	Aminulla	...	22	Street begger	Septicaemia	Rt=.44 Lt=.26 Rt=1D Lt=1D
26.	J. Alam	...	20	Labourer	Haemothorax & septicaemia.	Rt=.26 Lt=.24 Rt=Normal Lt=1D
27.	S. Das	...	26	Bearer	Enteric 22 days.	Rt=.29 Lt=.24 Rt=1D Lt=1D
28.	N. Khan	...	40	Durwan	Amyloid disease with chr. osteomyelitis.	Rt=.22 Lt=.23 Rt=2D Lt=Normal

The differences therefore between the two sets of prints are not such as to suggest that the administration of spinal anaesthesia produces any lowering of the arch.

#### Paralysis of inferior extremities (Table IV)

The next series of 20 patients had complete sensory and motor paralysis of both inferior extremities. Most of these patients were cases of spinal injury with compression fracture of the vertebrae and involvement of the cord. Two were cases of transverse myelitis of syphilitic origin and one was a case of cerebral thrombosis with hemiplegia. Since the postural tone is a reflex mechanism depending primarily on the integrity of the rubrospinal tract, it would be expected that in these conditions there would be lessening or abolition of the tone and the consequent falling of the arch according to the postural theory. Such lowering of the arch is not evident in the foot prints of the 20 patients examined (Fig. 12). The arch was as prominent as in normal individuals and the rigidity and the integrity of the foot were quite normal. The average arch fraction was .32.

1st degree of weakness	..	30%
2nd degree of weakness	..	43%
3rd degree of weakness	..	10%
4th degree of weakness	..	Nil
Normal feet	..	15%

#### Acute inflammatory leisons of the leg and foot (Table V)

The 3rd series included 19 patients who were suffering from acute inflammatory leisons affecting the leg and foot. These included cellulitis foot, osteomyelitis foot, compound infected fractures around leg and foot etc. Under these conditions it is supposed, according to the postural theory, that there would be inhibition of the postural tone of the muscles which are included in the inflammatory area and consequent falling of the arch. That there is no such reduction in the height of the arch is plainly evident from the foot prints obtained in

such cases (Fig. 13). The average arch fraction was .34.

1st degree of weakness	..	47%
2nd degree of weakness	..	22%
3rd degree of weakness	..	6%
4th degree of weakness	..	3%
Normal feet	..	15%

The inflammatory disturbances were not deep or severe enough to affect the ligamentous structures of the feet to a great degree. When these capsular ligaments are really affected, as they are, in extensive gonorrhoeal infections of the foot, there is rapid falling of the arch proving the importance of the ligaments in the maintenance of the arch.

#### Acute toxæmic conditions (Table VI)

The fourth series included 28 patients who have been suffering from acute toxæmic conditions such as enteric fever, pneumonia and other long continued illnesses. It is held that under these conditions there is a reduction of the general tonus of the muscles of the body and so a lowering of the arch is to be expected. Evidence of decrease of muscular tonus in such toxæmic states is furnished by (a) general flaccidity of the muscles throughout the body (b) Loss of the normal spinal curvatures. (c) Difficulty of and weakness in raising the head, sitting up, standing up etc. in the convalescent stage. It will be seen that the arches in such patients are well developed (Fig. 14). Included in the series is a print of a congenital diabetic case (No. 3—Table 6—No. 15—Fig. 14). This patient has been in and out of hospital for a number of years and is now extremely emaciated and run down. His muscles are all flabby and apparently have little postural tone. His arches however are well developed and conform to the type of bare footed individuals (No. 15 Fig. 14). This case proves also that the failure or lowering of the arch is not associated with wasting or atrophy of the muscles and therefore cannot be said to depend upon its tone. In this series the average arch fraction was .31.



TABLE VII

No.	Name	Age	Stage of Pregnancy	Arch Fraction	Degree of Weakness
1.	Subasini Das	25	Abortion 5 months	Rt = .30 Lt = .23	Rt = 2D Lt = 2D
2.	Charu Haldu	42	2 Days after labour	Rt = .48 Lt = .44	Rt = 3D Lt = 2D
3.	Rashmoni	22	1 Day "	Rt = .31 Lt = .13	Rt = 2D Lt = N
4.	Rama Dasi	26	3 Days "	Rt = .28 Lt = .28	Rt = 1D Lt = 1D
5.	Numala Roy	21	1 Day "	Rt = .40 Lt = .38	Rt = 3D Lt = 2D
6.	Puspa	32	8 Hours "	Rt = .38 Lt = .39	Rt = 1D Lt = N
7.	Hari Dassi	22	2 Days "	Rt = .29 Lt = .31	Rt = 1D Lt = 2D
8.	Niharbala	21	1 Day "	Rt = .97 Lt = .98	Rt = 4D Lt = 4D
9.	Mrs. Milston	23	Pregnent 8 months	Rt = .89 Lt = .80	Rt = 3D Lt = 3D
10.	Gola Bibi	20	1 Day after labour	Rt = .26 Lt = .16	Rt = 3D Lt = 2D
11.	Mrs. Bhattacharya	21	4 Days "	Rt = .21 Lt = .24	Rt = 2D Lt = 1D
12.	Mrs. Biswas	23	6 Hours "	Rt = .19 Lt = .16	Rt = 2D Lt = 3D
13.	Mrs. Bhattacharya	25	1 Day "	Rt = .10 Lt = .20	Rt = 3D Lt = 2D
14.	Basirani	25	Anaemia with pregnancy full term	Rt = .31 Lt = .34	Rt = 2D Lt = N
15.	Kunti Devi	23	Pregnancy 9 months	Rt = .44 Lt = .38	Rt = N Lt = N
16.	Sakina Bibi	23	1 Day after labour	Rt = .60 Lt = .30	Rt = 2D Lt = 1D
17.	Bina Dasi	18	1 Day "	Rt = .41 Lt = .26	Rt = 1D Lt = 3D
18.	Dhalia	26	2 Days "	Rt = .29 Lt = .16	Rt = N Lt = 1D
19.	Mrs. S. Das	18	Full term pregnancy	Rt = .18 Lt = .23	Rt = 2D Lt = 1D
20.	Luxmi	26	" "	Rt = .12 Lt = .10	Rt = N Lt = N
21.	Kanchi	25	2 Days after labour	Rt = .51 Lt = .51	Rt = 1D Lt = 1D
22.	Golapi	20	1 Day "	Rt = .14 Lt = .10	Rt = 2D Lt = 2D
23.	Mahamaya Dutt	25	1 Day "	Rt = .23 Lt = .17	Rt = 1D Lt = 1D
24.	Shanta Maya	22	2 Days "	Rt = .38 Lt = .25	Rt = 1D Lt = 2D
25.	Prativa	30	11 Hours "	Rt = .88 Lt = .52	Rt = 4D Lt = 3D
26.	Sarojini	20	1 Day "	Rt = .43 Lt = .44	Rt = 2D Lt = 2D
27.	Bhaktilata	30	4 Days "	Rt = .27 Lt = .11	Rt = N Lt = 1D
28.	Dipali	30	2 Days "	Rt = .26 Lt = .26	Rt = 1D Lt = 1D
29.	Charu Dasi	32	1 Day "	Rt = .31 Lt = .28	Rt = N Lt = N
30.	Hamidan Bibi	26	2 Days "	Rt = .44 Lt = .36	Rt = 2D Lt = 2D

TABLE VIII

No.	Name	Age	Cause of Amputation	Arch Fraction	Degree of Weakness
1.	Mahatab	22	Extensive crushed injury left leg.	.45	3D
2.	Dukhi	60	Compound fracture leg with gas gangrene.	.22	N
3.	Nagina	31	Compound fracture both bones of the leg with extensive infection.	.24	1D
4.	Osman	48	Extensive lacerated injury leg with compound fracture.	.32	1D
5.	Pirmalli	60	Extensive crushed injury leg.	.18	1D
6.	Chammal	26	Chronic extensive osteomyelitis leg.	.42	N
7.	Umapada	42	" "	.36	N
8.	Sakri	45	Compound fracture leg with extensive infection.	.22	1D
9.	Bistu	35	Extensive crushed injury leg.	.18	N
10.	Rambaran	24	" "	.14	N
11.	Sakur	34	Gas gangrene following infected lacerated injury leg.	.36	1D
12.	Dukhan	26	Compound dislocation knee joint with infection.	.31	2D
13.	Ghuram	16	Crushed injury leg.	.12	N
14.	Mangal	29	" "	.38	1D
15.	Taher Ali	16	Gasgangrene leg following lacerated injury.	.20	1D
16.	Md. Yusuf	42	Extensive lacerated injury leg.	.12	1D
17.	M. M. Ali	30	Extensive crushed injury leg.	.21	1D
18.	Jaytan	21	Infected crushed injury leg.	.29	2D
19.	A. Khalek	36	" "	.34	2D
20.	Abdur Rahaman	36	Compound fracture both bones of leg with osteomyelitis.	.24	2D

1st degree of weakness	..	47%
2nd degree of weakness	..	15%
3rd degree of weakness	..	4%
4th degree of weakness	..	Nil
Normal feet	..	33%

### Pregnancy (pre- or post-partum stage) (Table VII)

Foot prints of 30 patients in late stage of labour or immediately after child birth were obtained (Fig. 15). Two factors which can influence the arch of the foot operate during the stage of pregnancy. One is the general reduction of tone of all the muscles of the body as evidenced by the flaccidity of the muscles and the other is the relaxation of the ligaments, mainly in the pelvic joints but also to a lesser extent throughout the other joints of the body.

It would be expected therefore that in pregnancy and especially immediately after labour the arch of the foot should show some evidences of lowering—at least in some of the cases and in fact repeated pregnancy is mentioned as one of the causes of acquired flatness of the foot (Gellhorn—1917).

The foot prints obtained in my cases prove the veracity of this statement. Of the 30 patients examined, there are some, whose foot prints correspond to those of the booted people viz. there is abduction of the forepart of the foot with increase of the arch fraction. Moreover in 3 cases the arch is nearly flat and the arch fraction nearly approximate unity viz. in cases of Mrs. Milston, Prativa (Rt. foot) and Niharbala. In the remaining patients the foot prints still correspond to those of the bare footed type with well marked arch and low arch fraction. Average arch fraction .45.

1st degree of weakness	..	26%
2nd degree of weakness	..	34%
3rd degree of weakness	..	26%
4th degree of weakness	..	5%
Normal feet	..	12%

### Recently amputated legs (Table VIII)

19 foot prints were obtained from recently amputated legs (Fig. 16). The amputa-

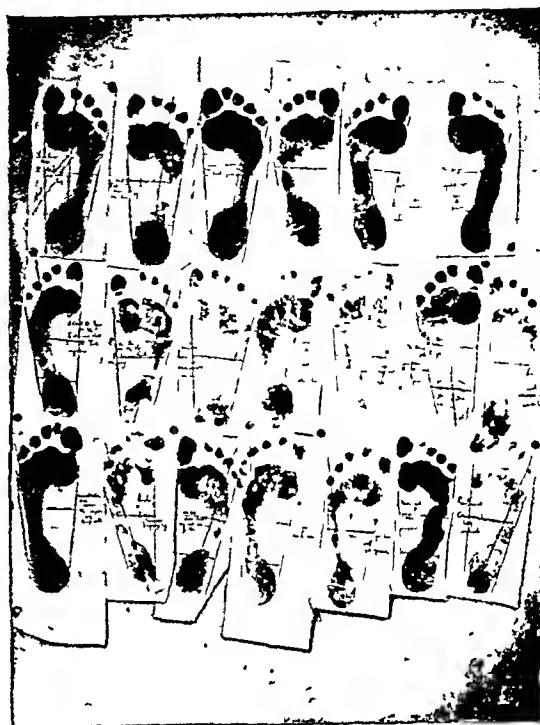


Fig. 16.  
Foot-prints of recently amputated legs.

tion was done for various reasons such as crushed injuries of the leg, gas infection etc. The prints were taken by placing the foot on a paper fixed on a wooden frame and applying moderate amount of force (72 lbs.) on top of it. If the arch was solely maintained by the postural tone of muscles, there would have been some lowering of the arch under these conditions. Such lowering did not occur, the arches were as prominent after as before the amputation and the placings of weight on the feet made little difference to the height of the arch.

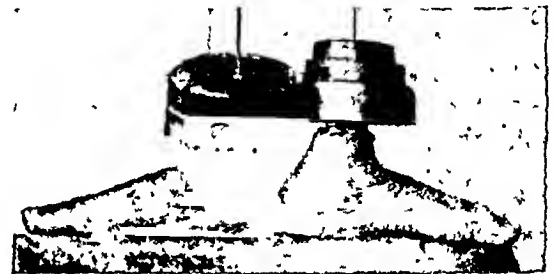
1st degree of weakness	..	42%
2nd degree of weakness	..	10%
3rd degree of weakness	..	14%
4th degree of weakness	..	Nil
Normal feet	..	32%

The average arch fraction in this series was .26.

### The influence of ligamentus support on the arch of the foot

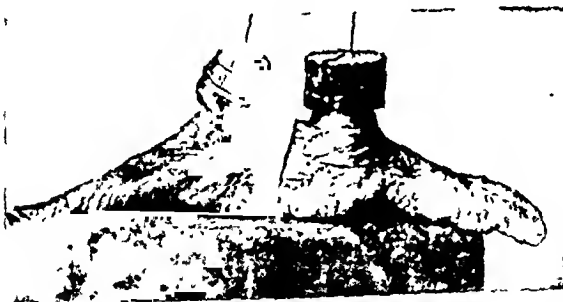
To determine the influence of the ligamentus structure on the arch of the foot I made a series of investigation. Immediately after amputation the amputated legs were injected with a fluid consisting of equal parts of glycerine, alcohol and carbolic acid and afterwards kept immersed in the same solution. The skin over the ankle and foot was undisturbed throughout all the experiments. The joints and tendon sheaths were thoroughly injected with a lubricant—oil of sesame was found to be satisfactory (Jones 1941). With such care, the experimental foot remained soft and pliable throughout the experiments. I made a small vertical incision on the medial side just below the head of the astragalus and sustentaculum in one of each pair of feet and with a long Paget's knife cut all the ligaments structures especially the planter calcaneo-navicular ligament, the long and short planter ligaments and the origin of the plantar ligaments and the planter fascia from the medial tuberosity of the os calcis. This foot was then mounted together with its fellow

(whose ligaments are intact) on a block of wood and about 36 lbs. of weight was placed on each (Fig. 17). Comparison of these feet whose ligaments have been cut with the normal feet (whose ligaments are intact) show how the former bereft of the ligamentus influence reacted to the load of weight. There is more or less lowering of the arch in every case. This can only be due to the absence of the ligamentous and the facial support as the muscles in both cases were already devoid of all postural tone. The lowest figure shows the height of the arch in a foot whose ligaments have been cut and the depression that occurs after putting 72 lbs. of weight on top of it.



Ligaments cut

Ligaments intact



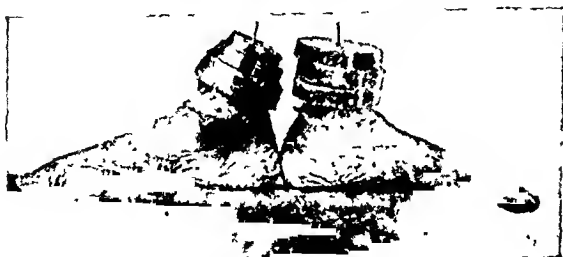
Ligaments cut

Ligaments intact



Ligaments intact

Ligaments cut



Ligaments intact

Ligaments cut -

Ligaments cut  
with weight (72 lbs.)Ligaments cut  
without weight

Fig. 17.



Fig. 18.

Foot-prints of infants from birth to 1 year.

### Stages in the development of the arch of the foot after birth

To examine the stages in the development of the longitudinal arch of the foot from infancy to adolescence, I obtained a series of foot prints from new born babies up to the age of 10 years. About 25 prints were obtained of each year and their relative comparison reveals many interesting features. The deductions made by the examination of these prints, though not conclusive by themselves, when co-related with findings from other examinations are corroborative and, therefore, are of importance.

#### BIRTH TO 1 YEAR

(28 pairs of feet—fig 18)

12 pairs of prints were obtained of babies within 24 hours of their birth. Of these 3



Fig 19.

Average picture of a foot-print from birth to 1 year.



Fig. 20.

Foot-prints of infants from 1 to 2 years.

are included in the figure. It will be seen that the foot of the new born is peculiar in many respects. The foot as a whole is more triangular than in the adult tending to be equilateral. The heel is small and narrow. The toes are divergent, spreading out in radiating lines from the heel. There is no arch—the arch fraction is 1. Another feature is the presence of the flexion creases like those present in the hand. The same characteristics i.e., the triangular feet with the narrow heel, absence of arch and the presence of flexion creases dividing prominent pads of fat are seen in the prints of adult monkeys' feet. The triangular character of the feet with the narrow pointed heel persists upto about the age of 5 months when the heels begin to broaden somewhat. The average arch fraction of this group of cases from birth to 1 year is .88. An average picture of the foot print of a new born is shown in Fig. 19.



Fig. 21.

Average picture of a foot-print from 1 to 2 years.

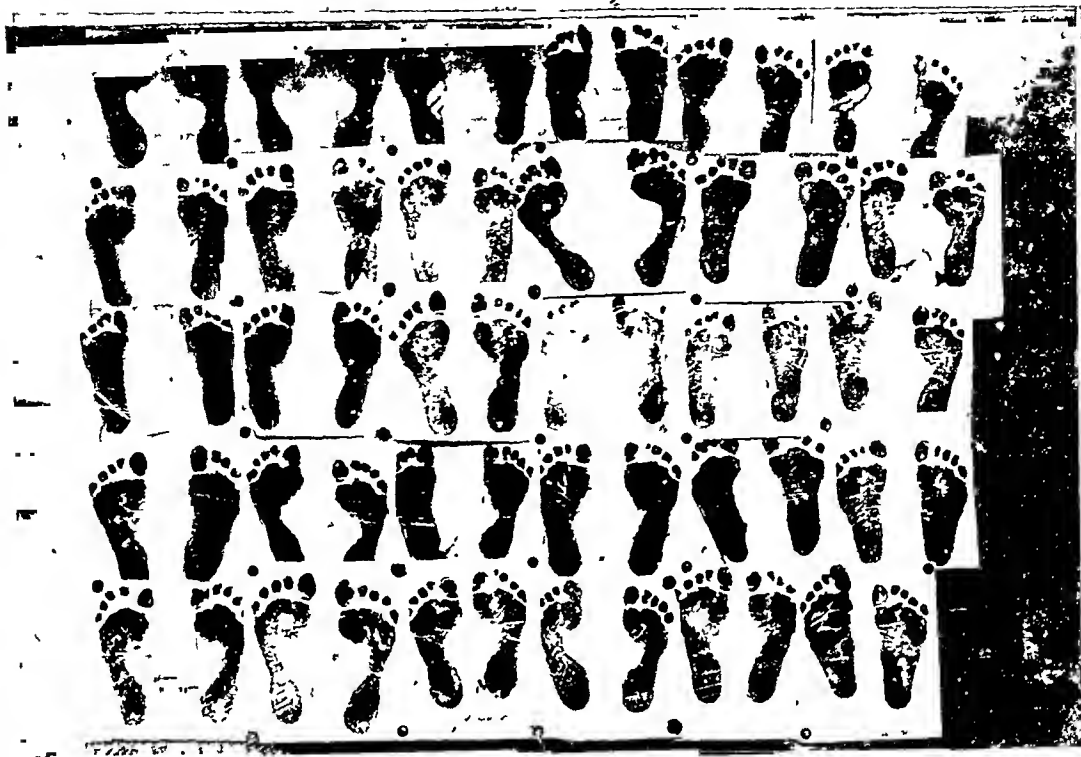


Fig 22

Foot-prints of children of 2 to 3 years.

#### 1 TO 2 YEARS

Above one year and upto 2 years, 29 foot prints were obtained. The general characteristics of the foot are the same as in the new born (Fig. 20) though the heel is less narrow and pointed. A new feature is the beginning of the appearance of the arch as evidenced by the slight concavity on the medial borders of the feet. This was not present in all the prints and in seven cases the arch was completely flat. The average arch fraction was .80. An average picture of the foot print at this stage would be as shown in the Fig. 21.

#### 2 TO 3 YEARS

Above 2 and upto 3 years of age the appearance of the arch is more prominent. 30 pairs of feet were examined (Fig. 22).



Fig. 23.

Average picture of foot-prints of children of 2 to 3 years



Fig. 24.

Foot-prints of children of 3 to 4 years.

The rudimentary arch was present in 56 of the 60 prints obtained. In four cases the arch was still nearly flat. The average arch fraction is .66. It will be seen that the concavity on the medial border is still not sharp and in those cases in which it is well developed, it conforms to the type seen in the booted individuals. In only one case it corresponds to the type seen in bare footed people. This shows that the arch is still very low and not well developed. Average prints at this stage would look like that shown in Fig. 23.

### 3 TO 4 YEARS

Above 3 years and upto 4 years (24 pairs of feet)—the arch is gradually taking the shape of adult proportions though it has not yet attained the average shape of the bare



Fig. 25.

Average picture of foot-prints of children of 3 to 4 years.



Fig 26  
Foot-prints of children 4 to 5 years

footed people except in 4 prints (Fig. 24). In another 4 prints the medial border is full and the arch flat. An average print of this stage is shown in Fig. 25. The average arch fraction of this group of cases is .61.

#### 4 TO 5 YEARS

Above 4 years and upto the 5th year of age (26 pairs of feet) the shape of the foot prints in some of the cases have assumed the adult bare footed type (Fig. 26) but in some it still shows different degrees of flatness. The average arch fraction is .51. An average type of foot print of this age may be seen in Fig 27.

#### 5 TO 6 YEARS

Above the age of 5 years the arches have reached adult proportions and in most of the cases the print shows the type seen in bare footed people though in a few cases the arch is still low (Fig. 28). The average



Fig 27  
Average picture of foot-prints of children of 4 to 5 years

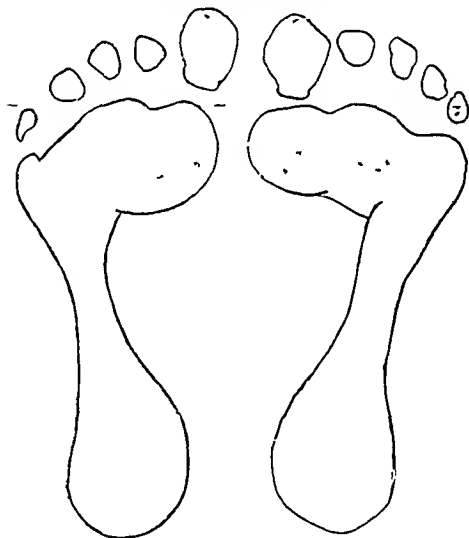


Fig 29-a  
Average picture of foot-prints above 6 years of age.

arch fraction of the foot prints between the ages 5 to 6 is .42.

#### 6 TO 10 YEARS

Above the ages of 6 years and upto the age of 10 years the prints are all included together and show well developed arch in every case (Fig. 29). The average arch fraction of this group is .39.





Fig. 28.

Foot-prints of children 5 to 6 years.

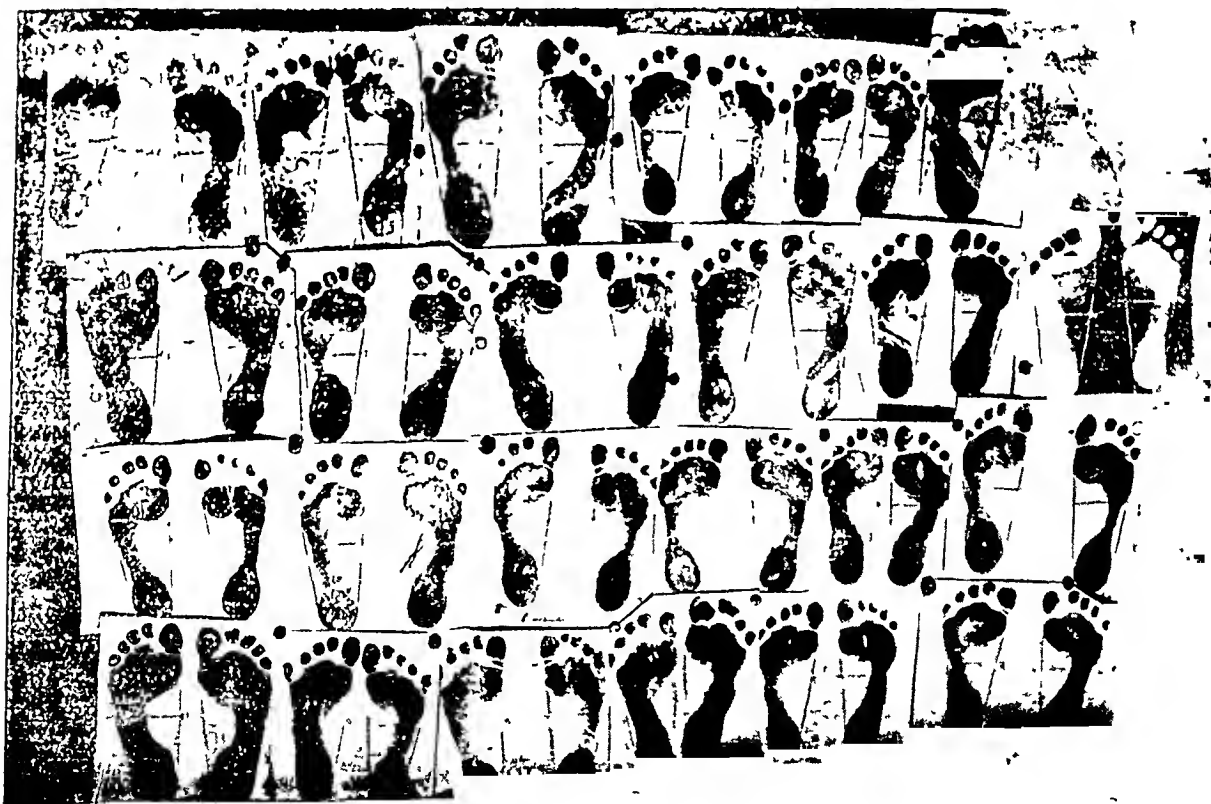


Fig. 29.

Foot-prints of children 6 to 10 years.

It will be conceded therefore that the well formed arch of the foot that we see in adult bare footed people is of gradual development. As seen in the series of prints, the medial border becomes increasingly more concave from the age of 6 months and assumes adult shape and proportion after the age of 5 years.

If a graph is drawn in which the abscissa show the age of the child and the ordinate the average arch fraction each year it will

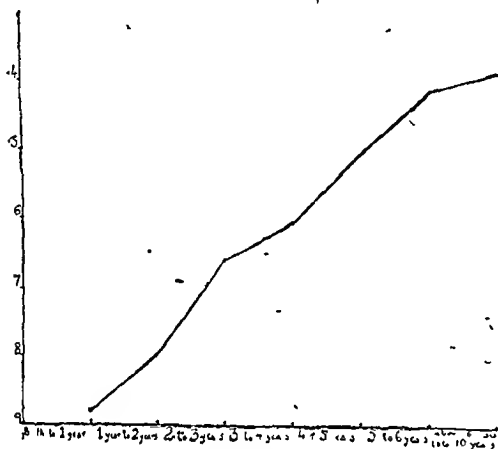


Fig 30.

Graph showing arch fraction with the increasing age of children.

form a line (as shown in the Fig. 30), ascending upwards, showing that the arch fraction gradually diminishes and therefore the height of the longitudinal arch gradually increases from birth upto the age of 5 years.

Age	Average Arch Fraction
Birth to 1 year	.. .88
1 to 2 years	.. .80
2 to 3 years	.. .66
3 to 4 years	.. .61
4 to 5 years	.. .51
5 to 6 years	.. .42
above 6 years & upto 10 years	.. .39

A similar opinion is expressed by Bloxom who studied the feet of a large number of infants and children. He writes "The rate

of development of the feet and its longitudinal arch varies considerably but as a rule progresses most rapidly in the period from 1 to 4 years. There is no essential difference between boys and girls in the rate of development of the arches. There are a certain number of children whose feet continue in a non-developing stage and corrective measures applied over years do no good. Up to the time of writing, no foot in the developing group that was subsequently re-examined has returned to the non-developing state."

From this finding of slow and gradual development of the arch of the foot as the child increases in age, certain conclusions can be drawn. It is clear that the development of the arch cannot be due to the appearance of postural tone in the anti-gravity muscles of the leg as explained by the adherents of the postural theory. If that was so, the arch would have been present in its fully developed stage by the age of 18 months when the child had assumed erect position and learnt to walk.

All other characteristics of the human anatomy such as holding up of the head (3 months), sitting upright (6 months), standing erect (1 year) which appear in this period of transition and which are said to be due to the assumption of this postural tone of the anti-gravity muscles are complete within this 18 months period and it is difficult to understand why the arch of the foot, if it was due to the same cause, should appear so late and so slowly and gradually.

Instead, this gradual appearance of the arch of the foot and its assumption of adult proportions after the child has attained a number of years suggests, that there is a slow process at work. As will be shown later on the proportion of soft tissues, fasciae, fat and muscles is comparatively greater in the foot of the new born babies than in the adult feet (Fig. 31). This preponderance of soft tissues relative to the skeletal element persists—though in diminishing degree—until about the age of



Fig. 31.

Dissection of feet of a new born baby to show how the arch is hidden by soft tissue element.

5 years. Is it not rational therefore to conclude that the appearance of the arch in the feet of human infants is due to this gradually increasing disproportion of skeletal and soft tissues as they grow up and that the arch assumes its adult proportions when this ratio is stabilized. The causes of diminution in the proportion of soft tissues in the feet are (a) the gradual atrophy of the fatty elements—a phenomenon which also takes place everywhere else in the body as the child grows up—as evidenced by the loss of roundness in the shoulders, hips, face etc., & (b) the increasing stiffness and inelasticity of the ligaments which fixes the arch and prevents the depression.

After examination of the feet of about 200 children of different ages, it was easy to see that the feet of the infants as they grew up became increasingly stiff and rigid. Within the uterus the feet are so pliable that they assume a completely inverted position (Keith 1933). After birth the feet are very soft and resilient and the range of movement among the different joints is

considerably greater than in the adult feet. The inverted position is gradually lost and according to Sweetapple (1932) the majority of the feet in infants assume a calcaneo-valgus position.

Persistence of the uterine inverted position and non-assumption of the everted attitude is according to Keith (1933) and Whitman the cause of the commonest foot deformity of infants—talipes equinovarus.

The resiliency, suppleness and the range of movement of the infant's foot gradually diminishes as the child increases in years and it was found that the same rigidity and fixity of the adult foot that was previously described even in bare footed persons is assumed by the child's foot at or after the age of five years. It is therefore rational to say that the same factors which cause the rigidity also reveal the arch in the child's foot.

The views of certain other writers as regards the development of the arch in a baby's foot may here be quoted. Elmslie

(Practitioner—July, 1930) says that there is no arch, when a child begins to walk—with the weight chiefly on the inner side and the feet apart. When walking improves, the feet are brought closer together and weight is gradually thrown on the outer side. This usually takes a few months, during which the arch develops. Lake (1935) says that the apparent depression of the arch of the foot in a baby is more due to the contour of the soft parts than to the rigid skeletal basis. Normally there is a well developed pad of fat under the instep, which obscures the outline of the cartilages, but in wasted infants, when the pad has disappeared, a well marked arch can be seen and the dissection of the skeletal basis confirms this observation. Ontogenetically and perhaps phylogenetically the development of an arch is foreshadowed long before any question of postural tonus comes into play.

Bankart—The child's foot is flat, because postural tone has not developed in the anti-gravity muscles. As the child gradually learns to walk, postural tone is developed and the tendency to passive abduction and eversion is from that time onwards, resisted by tonic muscular activity.

Lewin (1931)—The foot print of the new born infant is inadequate and misleading in that it usually looks flat because the bony arch is obliterated by a pad of fat. In fact, the feet of the new born infant reveals in cross section a definite bony arch but in a position of pronation to which the term pes valgus has been applied.

Henke (1859), Hueter and Lorenz (1883) considered that the foot is flat in all new born infants, while Kirmission (1898) considered that the arch is formed after birth under the influence of the contraction of muscles which become active at the time of walking.

Bane (1892) and Hohm (1932) through longitudinal section of the foot proved that a plantar arch exists at the time of birth and is buried in the mass of fatty tissue which is very well developed in this region in the newly born.

Higgs (1937) says that the apparent flatness of the foot in a baby is due to the calcaneo-valgus position (while *in utero*) and overstretching of the invertor and adductor group of muscles. If this is not corrected in time, congenital flat foot results.

Keith (1933)—At birth the child is flat footed when the weight of the body rests on it—the head of the astragalus touches the ground. When the muscles are removed by dissection, the foot of the newly born child shows a well developed arch. The arch becomes stable as the child learns to walk.

#### Embryological investigation of the development of the arch of the foot

During the course of my embryological investigation, I examined the feet of about 200 fetuses. Some of them were amongst the embryological collection of the museum of the department of anatomy of the Calcutta Medical College, while others were specially obtained from the Eden and the Sambhu Nath Pandit Hospitals. The fetuses were of different ages—the smallest was 8.5 mm C.R. length, and the largest were full time fetuses.

A preliminary naked eye examination of the feet of the very small fetuses and their comparison with the hands revealed interesting features (Fig. 32). It will be seen that at the 8.5 mm C.R. length stage (approximately 5th week), the limb buds have just appeared and are directed at right angles to the axis of the body. There is no differentiation of the limbs into different segments. The hand and foot are represented by circular pads at the ends of the extremities and the digits have not appeared.

At the 16 mm. C.R. length stage (approximately 6 weeks), the extremities both upper and lower show the beginning of the differentiation into three segments (thigh, leg and foot—the arm, fore-arm and hand). The digits have appeared both in the hand as well as in the foot. It will be seen that both in the hand and in the foot, the digits

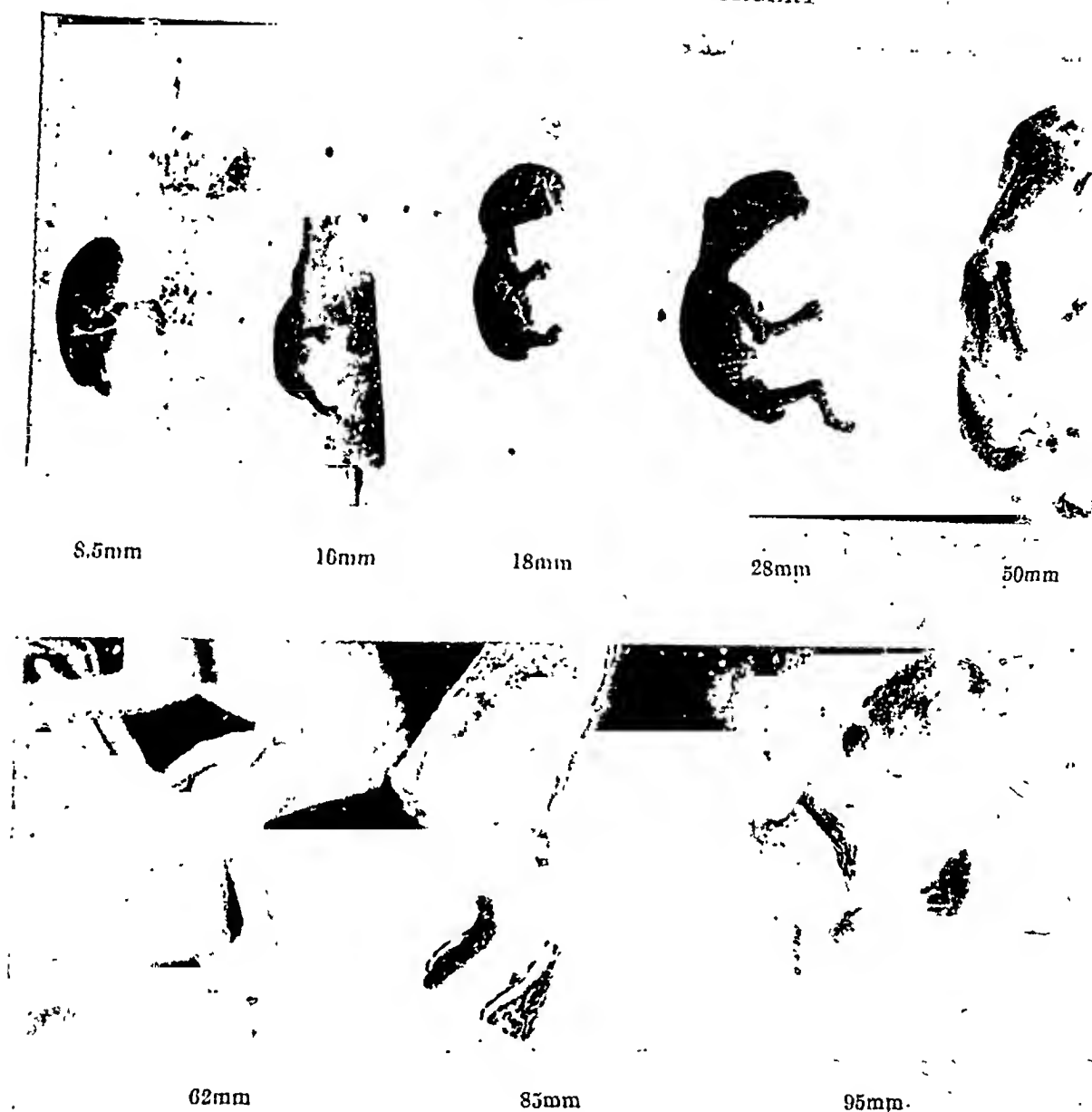


Fig. 32.

Stages of development of the foot and longitudinal arch in the small foetuses

are radially divergent and that both the hallux and the pollex are abducted away from the middle line. There is no heel and the foot is in the same axis as the leg. In fact both the hand and the feet look extremely alike. Another feature is that though the upper extremity continues to be directed vertically, the lower shows the beginning of the inward rotation. The same features are illustrated in a foetus of the 18 mm. C.R. length stage and there is pro-

bably a little more abduction of the pollex here as compared to the hallux. The heel is still not formed and the foot and the leg are in the same axis.

At the 28 mm. C.R. length stage (approximately 8th week), the differentiation into the three segments is a marked feature and the rotation of the lower extremity is complete. The shape of the hand and the feet are now different. The digits of the hand are spread out and are longer, the pollex

continues to be abducted and in a different axis from the rest of the digits and therefore cannot be seen. In the feet, the hallux has lost its abduction and is adducted to the other digits. The heel has appeared and the foot is at an angle to the axis of the leg.

At the 50 mm. C.R. Length stage (approximately 10th week) the same characteristics of the developing foot are evident in a more marked manner. The rotation of the foot is complete and it is at right angles to the axis of the leg. The heel is quite prominent. With further growth of the foetus in length as in 62 mm. stage, 85 mm. stage and 95 mm. stage, the development of the heel is seen to be progressive until at the 95 mm. stage it assumes adult proportions.

This ontogenetic study of the development of the foot reveals that the appearance and growth of the heel is the most important single factor in the formation and assumption of shape of the human foot. The development of the heel in the human foot corresponds to Wolff's law which says that the structure in a living individual conforms with the manner of its use. Such structural changes definitely tend towards improving the structure for a more efficient performance of the altered function. This structural peculiarity, if common to a class of animals, will if once acquired, be transmitted to subsequent generations and will make its appearance at a certain stage in the life history of the species. That the human foot, of all organs, should show the most pronounced structural characteristics seem obvious because of its specialized function and the nature of the burden it has to carry. No other part of body structure is affected by such violent forces as are exerted upon the comparatively small bones of the feet. In them the entire body weight is concentrated and its great stresses magnified by leverage. The average total of lbs. per minute transmitted by the foot bones is far greater than in any other member of the body. Consequently if any part of the entire skeleton may be supposed to

show the influence of function as a remodeling factor it would most surely and conspicuously be the foot.

According to Franz Weidenreich (1923), the calcaneus is the morphological kernel of the foot problem. Owing to the upright posture of man, the centre of gravity has shifted backward and this together with the necessity of obtaining a good leverage in the weight bearing foot causes the calcaneus to expand downwards and backwards. X-ray of the calcaneus shows that in man, the bony trabeculae are directed backwards and downwards instead of forwards and downwards as in the anthropoid apes. Lake (1937) makes an exactly similar observation, "the arch is developed because man when he adopted the upright position needed support for his foot behind the axis of the ankle joint in order to keep the line of the centre of gravity within the base. Upright position caused the large calf muscles to pull very strongly upwards and a great weight of leverage was required of the ankle joint. By Wolff's law, bone would be formed in the proper place and to the extent necessary to resist the stresses it encountered and the os calcis therefore developed in direct opposition to the stresses produced by the calf muscles in accordance to this law. The arch is not a sinuous curve but a triangular structure the very existence of which depends upon the development of the heel downwards and backwards." According to Keith (1933) the development of the arch is not only due to the development of the os calcis and the prolongation downwards and backwards of the heel but also due to the growth of the tarsal bones as a whole especially the astragalus, scaphoid, cuneiform, and cuboid.

To examine the architecture of the foetal feet, I made two preparations of each specimen of foetal foot (Fig. 33). One (A) was a sagittal section through the leg, heel and obliquely through the 1st metatarsal bone. My idea was to show the relative arrangement of the tuberosity of the os calcis, the astragalus, the scaphoid, the 1st cuneiform,



B

A

Fig. 33.

Sagittal section and dissection of a foetal foot, male, 9 months.

the 1st metatarsal and the phalanges of the great toe in one section and it was not possible to do that unless the section was oblique—because a vertical section through the 1st metatarsal would only pass through the sustentaculum tali of the os calcis as the tuberosity lies more laterally. The second specimen (B) was prepared by removing all the soft tissues from the sole of the foot, leaving only the ligamentous and the skeletal elements. 40 such specimens of different foetal ages were prepared (Table IX).

The smallest foot was of a foetus of 13 cm. C.R. length and the length of the foot was 2.35 cm. The longest foot was 15.5 cm. in length. In each specimen a number of measurements were taken. (1) Length of the foot being the distance from heel to the tip of the great toe. (2) The length of the os calcis being the distance from the heel to the centre of the talo-calcaneal joint. (3) The length of the tarsus being the distance from the heel to the centre of the cuneio-metatarsal joint. (4) The length of the 1st metatarsal bone. (5) The length of the 1st phalanx of the great toe. In addition measurements of the height of the soft tissues were taken in each specimen at 3 levels (a) at the astragalo-scaphoid joint, (b) at the cuneio-metatarsal joint, and (c) at the metatarso-phalangeal joint (Table IX).

Examination of this series of dissected foetal feet would show that the longitudinal skeletal arch is present in every instance and the reason why they are not at once obvious is because they are hidden by the mass of fibro-fatty and muscular tissue.

To determine the disposition of the skeletal structure in still smaller feet, I collected a number of foetal feet of the stages of 28 mm., 50 mm., 62 mm., 85 mm. and 95 mm. C.R. length. Sagittal sections of these very small feet were made. As the feet of



14 cm  
C.R. Length

13 cm  
C.R. Length

13 cm  
C.R. Length



Fig. 34.

Section of feet of a 13 cm foetus stained by Indian ink method.

these foetuses were very small and the difference between the soft tissues and the cartilage was scarcely noticeable with the naked eye—I tried to find out something which will stain the soft tissues but will not stain the cartilage. Experimenting with different dyes, it was found, that Indian ink answered the purpose best. The dissected specimens were kept immersed in a solu-

TABLE IX

No	Age of Foetus	Sex	Cartilaginous arch	Length of Heel	Length of Tarsus	Length of Metatarsus	Length of 1st Phalanx	Height of Soft tissues			Length of Foot
								Astragalo-navicular Junction	Cuneiform Metatarsal Junction	Metatarsal Phalangeal Junction	
1. Full term	...	M	P	16mm	32mm	17mm	8mm	14mm	8mm	4.5mm	7.2cm
2. Full term	...	M	P	14mm	29mm	17mm	7.5mm	13mm	9mm	3.5mm	7cm
3. Full term	...	F	P	11mm	33mm	18mm	5mm	11mm	7mm	4mm	7cm
4. Full term	...	M	P	17mm	35mm	17mm	8.8mm	11mm	7mm	4mm	8.3cm
5. Full term	...	F	P	13mm	29mm	15mm	7mm	10mm	6.2mm	3mm	6.2cm
6. Full term	...	M	P	17mm	34mm	18mm	8mm	9mm	6.5mm	3mm	7cm
7. Full term	...	M	P	14.5mm	32mm	19mm	9mm	13mm	10mm	3.5mm	7.5cm
8. 8 months	...	M	P	12mm	29mm	15mm	6.8mm	9mm	5mm	3mm	6cm
9. Full term	...	F	P	16mm	33mm	18mm	11mm	—	—	—	7.1cm
10. 9 months	...	F	P	13.5mm	30mm	16mm	7mm	7mm	4mm	2.5mm	6.8cm
11. 8 months	...	M	P	14mm	30mm	15.5mm	7.5mm	10mm	6mm	4mm	6.4cm
12. Premature 6 months	...	F	P	10.5mm	24mm	11.5mm	6mm	6mm	4mm	2mm	5.2cm
13. Full term	...	M	P	15mm	31mm	18mm	—	12mm	7.5mm	3mm	7.1cm
14. 9 months	...	M	P	14mm	30mm	15.5mm	7mm	9mm	6mm	3mm	6.2cm
15. 8 months	...	F	P	11.5mm	27.5mm	13.5mm	—	16mm	5.5mm	4mm	6.2cm
16. 6 months	...	M	P	12mm	25mm	14mm	6.8mm	10mm	6mm	3mm	5.5cm
17. 8 months	...	M	P	12.5mm	30mm	16mm	6mm	7mm	4.8mm	2.5mm	6.8cm
18. 6 months	...	M	P	9.8mm	24mm	13mm	8mm	9mm	6mm	3mm	5.2cm
19. 7 months	...	M	P	12.5mm	27mm	15mm	7mm	11mm	6.5mm	4mm	6.3cm
20. 6 months	...	M	P	10.5mm	23mm	13.5mm	8mm	8mm	4.5mm	2mm	5.6cm
21. 6 months	...	M	P	10mm	24mm	13.5mm	8mm	8.5mm	5mm	2.5mm	5.3cm
22. 7 months	...	F	P	12mm	30mm	15mm	8mm	8.5mm	6mm	3mm	6.2cm
23. 7 months	...	M	P	11.5mm	25mm	14mm	8mm	8.5mm	5.5mm	3.5mm	5.5cm
24. 6 months	...	M	P	13.5mm	30mm	17mm	9mm	11.5mm	6.5mm	4mm	6.2cm
25. 5 months	...	F	P	11mm	22.5mm	13mm	6.5mm	6mm	5mm	2mm	5.4cm
26. 6 months	...	M	P	11.4mm	26mm	13.5mm	6.5mm	6.5mm	5mm	1.5mm	5.7cm
27. Full term	...	M	P	14.5mm	29mm	16mm	7.7mm	16.5mm	6.5mm	3.5mm	6.6cm
28. Full term	...	F	P	13mm	30mm	17mm	9.5mm	10mm	4mm	2mm	6cm
29. 8 months	...	M	P	15mm	31mm	17mm	8mm	10mm	5mm	2mm	6.4cm
30. Full term	...	M	P	15mm	32mm	17.5mm	8mm	7.5mm	5.5mm	3.5mm	7.1cm
31. 5 months	...	M	P	5mm	14.5mm	7.5mm	4mm	6mm	4mm	2mm	3.4cm
32. C. R. Length 14cm	...	M	P	6mm	15.5mm	8mm	4mm	6mm	4.5mm	2mm	3.5cm
33. C. R. Length 13cm	...	M	P	5.6mm	12.5mm	6mm	3mm	4mm	3mm	1.5mm	2.5cm
34. C. R. Length 19cm	...	M	P	8.5mm	19mm	11mm	5.5mm	8mm	4.5mm	3mm	4.3cm
35. C. R. Length 13cm	...	M	P	6mm	12mm	6.5mm	3mm	6mm	3mm	1mm	2.5cm
36. C. R. Length 13cm	...	M	P	5.5mm	11mm	6.5mm	3mm	5.5mm	3mm	1mm	2.35cm
37. Full term	...	M	P	14mm	31mm	17mm	9mm	13.5mm	9mm	2.5mm	6.7cm
38. 2 years	...	M	P	25mm	54mm	27mm	14mm	17.5mm	10mm	3.5mm	11.9cm
39. 4 years	...	M	P	40mm	76mm	37mm	18mm	31mm	17mm	11mm	15.5cm
40. 1 year	...	M	P	19mm	39mm	23mm	11mm	15mm	7mm	7mm	8.7cm



tion of Indian ink for 24 hours and on the following day were washed in water and dried in absolute alcohol. It was found that the soft tissues had been stained deeply black and by contrast the cartilage looked white. The method was also very suitable for photographing the parts for the sharp contrast between the two tissues made them easily discernible (Fig. 35).

It will be seen that the arch is fully developed even at the stage of 28 mm. C.R. length and in it and in the subsequent stages, the inclination of the heel and contour of the longitudinal arch correspond to adult proportions.

It can be said therefore from this series of investigations that the skeletal structure of the human foot is disposed in the form of an arch from the stage of 28 mm. C.R. length, if not earlier. It is generally agreed that the anatomical bony architecture of a

part, as seen in the adult, is defined in its cartilaginous precursor and however much the individual bones may undergo modifications in shape or size due to the stress and strain of the mode of life of the individual, these modifications only affect the details and the fundamental anatomical structure remains on the whole unaltered throughout life unless disturbed by a gross deformity.

If this be so, the longitudinal arch of the foot, as it is seen in the foetal feet from a very early stage, is a definite anatomical structure produced in its adult proportions as soon as the heel has developed in the foetal skeleton (28 mm. C.R. length). "The modifications which the individual bones undergo and the changes which these modifications produce on the arches are imposed on the skeletal form which is primarily an arched one." (Bruce and Walmsley—1938). This finding proves once again



28 mm C.R. Length

58 mm C.R. Length



85 mm CRL

62 mm CRL

95 mm CRL

Fig. 35.

Section of feet of very small fetuses stained by Indian ink method.

that the development of the arches of the foot cannot be ascribed to the postural tone of the antigravity muscles, since there can be no question of the postural tone at such an early stage of foetal life.

Certain other conclusions were deduced from this series of investigations. The average length of the heel, tarsus and the metatarsus as compared to the total length of the foot in foetuses above the stage of 20 cm. C.R. length are as follows:—

(1) The average length of the heel is 21% of the length of the foot.

(2) The average length of the tarsus is 44% of the length of the foot.

(3) The average length of the metatarsus is 26% of the length of the foot.

(4) The average length of the phalanx is 16% of the total length of the foot.

As regards the soft tissues, (1) the average height of the soft tissues at this stage at the level of the astragalo-scaphoid junction compared to the total length of the foot is 18%. (2) the average height of the

soft tissues at the cuneio-metatarsal articulation compared to the total length of the foot is 9%. (3) The average height at the metatarso-phalangeal junction to the total length of the foot is 4%.

For purposes of comparison I took similar measurements of the different constituents of the foot in a number of very small foetuses and in several adult men.

The readings obtained in the small foetuses are tabulated below:—

The average measurements of the different constituents in these ten very small feet were as follows:—

(1) Heel—14.5% of the length of the foot.

(2) Tarsus—35.4% of the length of the foot.

(3) Metatarsus—30.1% of the length of the foot.

(4) 1st Phalanx—21.1% of the length of the foot.

TABLE X

No.	Length of the foot	Length of the heel	Length of tarsus	Length of metatarsus	Length of 1st phalanx
1.	36mm	6mm = 16%	14mm = 38%	11mm = 27%	7mm = 19%
2.	24mm	3mm = 13%	9mm = 37%	7.5mm = 31%	5mm = 20%
3.	30mm	5mm = 16%	11mm = 36%	9mm = 30%	6mm = 20%
4.	20mm	3mm = 15%	7mm = 35%	6mm = 30%	5mm = 22%
5.	40mm	7mm = 17%	16mm = 40%	11mm = 28%	7mm = 17%
6.	16mm	2.5mm = 14%	6mm = 34%	5mm = 31%	4mm = 22%
7.	18mm	3mm = 14%	6mm = 33%	6mm = 31%	4mm = 21%
8.	15mm	2mm = 13%	4mm = 31%	4mm = 31%	3mm = 25%
9.	15mm	2mm = 12%	5mm = 33%	5mm = 33%	4mm = 25%
10.	24mm	4mm = 16%	9mm = 37%	7mm = 29%	5mm = 20%

TABLE XI

No.	Obtained from	Age	Length of foot	Length of heel	Length of tarsus	Length of metatarsus	Length of 1st phalanx	Astragalo-scaphoid junction	Cuneio-metatarsal junction	Metatarso-phalangeal junction
1.	S. N. P. H. Morgue	35	210mm	49mm = 24%	98mm = 47%	52mm = 24%	25mm = 12%	30mm = 14%	15mm = 7%	10mm = 4%
2	S. N. P. H. Morgue	42	250mm	48mm = 24%	96mm = 48%	50mm = 23%	24mm = 12%	26mm = 13%	14mm = 7%	8mm = 4%
3.	M. C. H. Morgue	26	250mm	54mm = 21%	110mm = 48%	56mm = 22%	28mm = 11%	24mm = 10%	16mm = 9%	10mm = 4%
4	M. C. H. Morgue	50	220mm	50mm = 22%	104mm = 47%	54mm = 24%	28mm = 12%	25mm = 11%	12mm = 6%	6mm = 3%
5	M. C. H. Morgue	54	180mm	40mm = 20%	82mm = 45%	44mm = 24%	20mm = 11%	16mm = 9%	8mm = 5%	6mm = 3%
6	M. C. H. Morgue	23	190mm	42mm = 21%	84mm = 44%	48mm = 25%	22mm = 11%	24mm = 12%	10mm = 5%	6mm = 3%
7	M. C. H. Morgue	20	176mm	38mm = 21%	84mm = 46%	44mm = 25%	20mm = 11%	10mm = 9%	8mm = 5%	4mm = 3%
8.	M. C. H. Morgue	27	230mm	52mm = 22%	110mm = 48%	58mm = 25%	30mm = 13	30mm = 13%	16mm = 7%	8mm = 3%
9.	M. C. H. Morgue	47	246mm	52mm = 21%	106mm = 44%	55mm = 23%	26mm = 10%	34mm = 13%	18mm = 7%	9mm = 3%
10	M. C. H. Morgue	35	225mm	51mm = 23%	108mm = 46%	56mm = 25	26mm = 11%	36mm = 15%	16mm = 7%	8mm = 3%

All these fetuses were below the stage of 20 cm. C.R. length. It will be seen that these measurements are different from those met with previously in fetuses of older age and new born babies. Here the length of the heel and the tarsus are comparatively less and those of the metatarsus and phalanges more than in the previous class. In fact it is seen that as the foetus increases in length and age, there is a progressive diminution of the lengths of the digits and metatarsus and progressive increase in the lengths of the tarsal section and the heel.

Similar measurements were taken in a number of adult amputated feet and the figures obtained are give below (Table XI). Included in the table also are vertical measurements of the soft tissues taken at three levels (a) at the astragalo-scaphoid junction, (b) at the cuneio-metatarsal junction, (c) at the metatarso-phalangeal junction (Table XI).

The diminution of the length of the digits and the metatarsals and increase of the length of the tarsal section and the heel is still more marked here. It can be said therefore that from foetal life onwards until adult proportions are reached there is a progressive diminution of the lengths of the digits and metatarsals and increase of the tarsal section and the heel.

Examination of the heights of the soft tissues in adult feet at the 3 levels mentioned and their comparison with those met with in foetal feet revealed what has been mentioned before that there is comparatively more soft tissue in foetal feet and this is the cause of the apparent flatness of the feet in fetuses and new born infants. At the astragalo-scaphoid junction of the adult foot, the average height of soft tissue is 11%, at the level of the cuneio-metatarsal junction the average height is 6.5% and at the metatarso-phalangeal junction the average is 3.5%. Comparison of these figures with those in foetal feet would show that at the 1st two levels, the proportions of soft tissues are much less.

The stages of the development of the longitudinal arch of the foot among the primates

To study the development of the longitudinal arch of the foot in different animals and especially among the higher primates I attended the Anthropology and the Zoology departments of the Calcutta University. I was able to collect specimens of the skeletons of the foot of the following animals and their examination and comparison with each other and with those of the human foot revealed interesting features.

The animals examined were :—

- (1) Lemuroide—Lemurs.
- (2) Cercopithecidae—Macque, Bahoos, Langurs.
- (3) Hylobatidae—Gibbon.
- (4) Pithecanthropoidae—Chimpanze.
- (5) Simiidae—Gorilla.
- (6) Homidae—Man.

LOWER PRIMATES

(1) *Lemuroid Class*.—One specimen of this class was seen in the museum of the Zoological department of the University of Calcutta (Fig. 36). The characteristics of the skeleton foot of this class to be noted

are (a) wide divergence of the hallux and its abductability. These animals are arboreal in habits and live on tree tops amongst branches that are quite large for their feet. They develop therefore the type of grasp that is known as the clinging type. (b) There is marked torsion of the hallux and the outer 4 metatarsals. This torsion of the metatarsals also helps the clinging type of grip. (c) The digital and metatarsal bones are very long compared to the tarsus. (d) Another characteristic to be noted is that the line of leverage passes through the 3rd metatarsal bone which is also the longest. This is known as the primitive line of leverage as contrasted with the humanoid line of leverage which passes through the second metatarsal bone. (e) The heel is very small and primitive. (f) There is no arch.

The lemur is a very interesting animal in the sense that it is considered by some persons to be the nearest approach among the present day animals to a creature which resembles man's ancestors at the time when the humanoid stock separated from the apes—perhaps 2,000,000 years ago. At this very early period, the primitive forerunner of man was arboreal in habits and the anatomy of the foot therefore showed mainly arboreal characters.

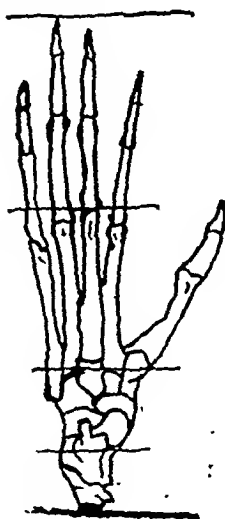


Fig. 36.

Skeleton of lemur's foot.

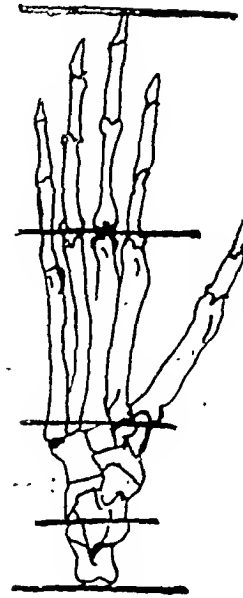


Fig. 37.

Skeleton of foot of baboon.

(2) *Baboon*.—This animal belongs to the group of catarrhine (old world) primates. As a rule the catarrhine primates are older and therefore more terrestrial in their habits than their platyrrhine (new world) relatives and this difference in the mode of their living is evident in their foot skeleton (Fig. 37). The characteristics of the baboon's foot are the following:—

- (1) The length of the metatarsals is marked and there is comparative shortness of the phalanges.
- (2) The absence or the very small amount of torsion of the outer metatarsals.
- (3) The line of leverage is still primitive and passes through the third metatarsal bone which is still the longest bone.
- (4) The tarsal segment is still small compared to the fore part of the foot.
- (5) The hallux is abducted and shows torsion.
- (6) The heel is more prominent than in the lemur's foot.
- (7) There is no arch.

It will be seen therefore that the baboon's foot shows a mixture of arboreal and terrestrial characters. The arboreal characters are manifested by the long fore foot, the abducted hallux showing torsion which indicates grasping function and the terrestrial characters are seen in the short phalanges and the prominent heel. "It is evident therefore that this species is unquestionably derived from arboreal ancestors and that they adopted ground habits before they had changed from the primitive to the humanoid line of leverage" (Morton).

(3) *Macacus*.—Characteristics of the monkey's foot are very nearly the same as those of the baboon and show the same ground ape features with lengthening of the metatarsals and comparative shortening of the digits (Fig. 38). There is less abduction of the hallux and torsion is very little. The fore part of the foot consisting of the digits and metatarsals are much longer than the tarsal part and the heel is horizontal as in the previous animals. The foot on the whole is of an arboreal type with terrestrial modifications. There is no arch.

(4) *Langur*.—The characteristics of the Langur's foot are practically the same as in

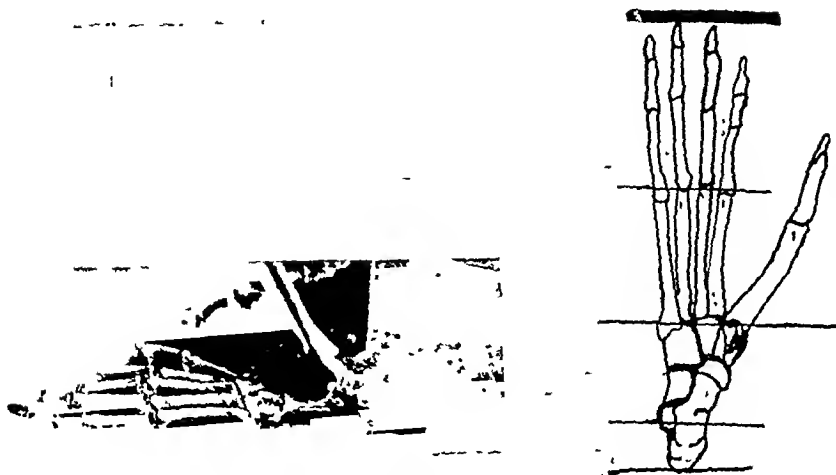


Fig. 38.  
Skeleton of foot of macacus.



Fig. 39.  
Skeleton of foot of langur.

the macacus. The digits and the metatarsals are very long, the primitive line of leverage through the 3rd metatarsal still persists and there is abduction and torsion of the great toe; the heel is small and horizontal (Fig. 39).

#### HIGHER PRIMATES

(5) *Gibbon*.—In contrast with the cynomorphae, such as the monkeys, typical

quadrupedal animals, a gibbon, along with the orang, chimpanzee and gorilla belongs to the sub-class of anthromorphia, i.e., specialised arboreal animals which when on the ground habitually assume semi-erect posture, supporting the weight of the forepart of the body upon ends of the fingers or more frequently upon the knuckles—the thigh and the leg being much shorter than the arm and the forearm. The

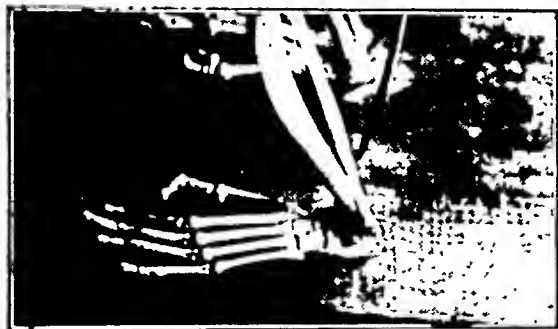


Fig. 40.

Skeleton of foot of gibbon.

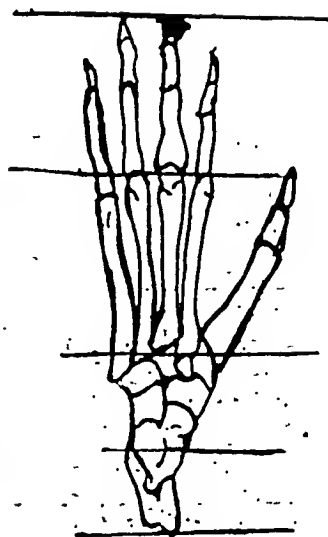
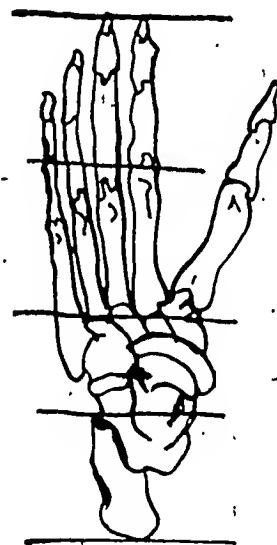


Fig. 41.

Skeleton of foot of chimpanzee.



gibbon however is a very small animal and lives an arboreal existence most of the time. The characteristics of its foot are the following (Fig. 40).

- (1) The humanoid line of leverage. The line of leverage for the first time passes through the second metatarsal bone which now becomes the longest bone.
- (2) The long digits and metatarsals and their marked torsion. Both the

digital segment and the metatarsals are very elongated and this and their torsion are adapted to maintain the erect posture of the body by their grasp upon the supporting branch.

- (3) The tarsal bones are short, and the heel is small and horizontal indicating lessened leverage demand upon the calf muscles.
- (4) There is no arch.

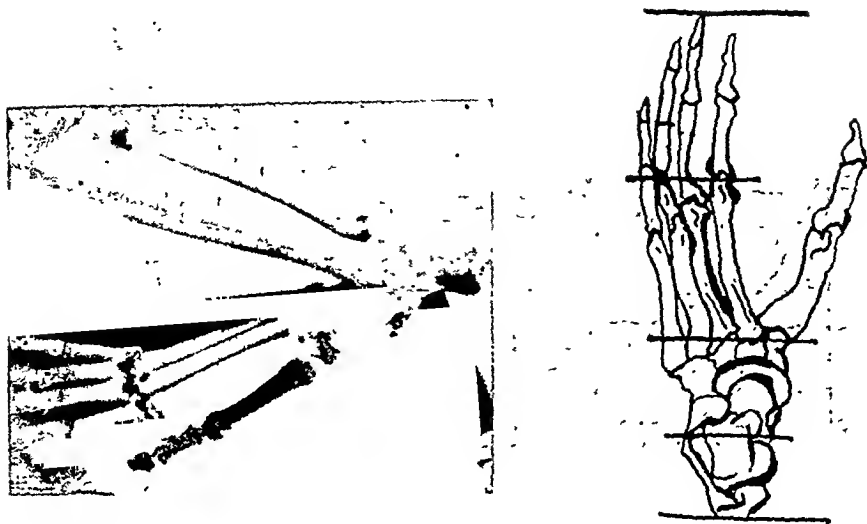


Fig. 42.

Skeleton of foot of gorilla (obtained from Zoological Dept., Benares University).

(6) *Chimpanzee*.—The chimpanzee is an animal higher than the gibbon in the anthromorphus scale and its foot, therefore, though resembling the gibbon in its essential characters, show some advancement in its terrestrial modifications (Fig. 41).

- (1) The bones are more massive though not to the degree seen in the gorilla.
- (2) The digital and metatarsal segments specially the former are shorter than in the gibbon.
- (3) The first metatarsal still shows abduction and torsion indicating grasping function which also is evident from the torsion of the other metatarsals.
- (4) The tarsal bones, as in the gibbon are comparatively shorter than in the gorilla and man.
- (5) The heel, though longer than in the gibbon, macacus or baboon is still comparatively short and the slight increase of its length indicates greater use of leverage function.

(7) *Gorilla*.—The gorilla's foot is of fundamental importance because it reveals characteristics that show the stages of evolution of the foot clearly and in fact the gorilla's foot is a transitory stage between the anthropoid apes and man (Fig. 42). The same arboreal characteristics seen in the foot of the chimpanzee are still present in a subdued degree but are overshadowed by other characteristics, that show that it has adopted a terrestrial mode of life and upright posture. "The gorilla has evidently become a ground dweller when his increasing bulk unfitted him for life amongst the trees" (Morton). The differences between the feet of the chimpanzee and the gorilla must therefore be associated with their change of habits and reveal the effects of terrestrial usage upon an arboreally developed foot. Compared with the chimpanzee the gorilla's foot (obtained from the museum of the Zoological department of the Benares Hindu University) shows more massiveness of structure and increase in bulk specially the heel. The abduction of the great toe though present is reduced and the hallucial and digital metatarsals show no torsion nor is the plantar curvature of the phalanges (seen in the chimpanzee's



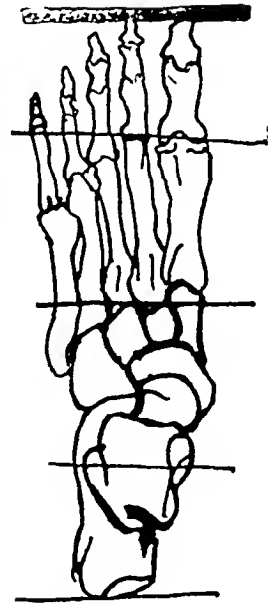


Fig. 43.

Skeleton of foot of man.

foot) present here. The plantar surfaces of the digits are therefore presented flatly to the ground.

The os calcis, especially the heel, is markedly strengthened and lengthened and this implies increased foot leverage. The comparatively short heel of the chimpanzee's foot indicates the low grade of leverage effort that characterizes the arboreal foot. In the gorilla a marked difference is found both in the length and the massiveness of the heel. Increased massiveness may be accounted for by the plantigrade posture of the foot but the lengthening of the heel is obviously the result of improved leverage function. Another very significant difference presented by the gorilla foot is the early development of the elements of the longitudinal arch. The structure as manifested in the human foot is a distinct product of improved terrestrial leverage function and its presence in a primitive form in the foot of the gorilla indicates early attainment of the same quality in that animal.

(8) *Human foot (Fig. 43).*—The modifications seen in the gorilla as the result of terrestrial habitat are carried to a much

further degree in man and the additional differences are the result of its "high degree of specialisation and of having started its terrestrial development from a more primitive type of arboreal foot than did the gorilla" (Fig. 43). The gorilla, in spite of its upright posture, is an anthropomorphous animal and makes use of its long upper extremities in locomotion; but man is entirely dependent on his feet and the upper extremities take no part in locomotion. It is no wonder therefore, that the human feet attain such specialised development and the longitudinal arch, which is an expression of grace and economy of effort in terrestrial animals depending on increased leverage, attains such predominance.

*Digital Segment.*—The digits are very short, specially the middle and the distal ones. The plantar surfaces are directed completely downwards.

*Metatarsal area.*—Torsion of the metatarsals is absent. The bones are reduced in length and are massive.

*Hallux.*—Abduction is absent. Its large size indicates the strength that is put upon this segment of the foot. There is no torsion. The outer side of the foot was the

predominant section in the lower primates, and therefore the outer metatarsals were more massive in size. As the animal began to adopt a terrestrial mode of life, the earlier supinated posture was modified by pronation and the inner side of the foot became more important and bore increased strain. This is seen to a lesser extent in the gibbon but in increasing proportions in the chimpanzee and the gorilla but it attains its highest development in man where the first metatarsal is about twice the size of the other outer metatarsal bones.

**Posterior Tarsal Section.**—The heel is massive and directed downwards and backwards. It is modified for weight bearing and also sustains the strong upward thrust of the calf muscles.

**Longitudinal arch.**—The longitudinal arch attains its greatest development in the human foot. It was seen that the arch made its first appearance in the gorilla foot although it was very small in height and not so efficient. A well developed arch is an expression of the judicious use of foot leverage.

This can be well illustrated by watching the gait of two persons—one with well developed arch and another with low arch and flattened feet. The former walks with easy grace. The centre of gravity is kept in advance and the two parts of the foot, the anterior and the posterior, act as two arms of the lever with the leg as the fulcrum. The impulse which is given to the body weight by each foot seems automatically to carry the foot forward into the next step. The other person has a different gait. He walks with an effort with shuffling foot steps. His centre of gravity is not kept in advance and instead of being impelled directly forwards, it is merely shifted obliquely from one foot to another. There is no leverage effort. Each foot has to be elevated and then shifted by voluntary effort to a forward position to receive the body weight.

The first example of gait is an illustration of judiciously used foot leverage for

which a well developed arch is necessary. This we find in modern man: For its development, comparative atrophy of the anterior section i.e. the digital and metatarsal segments and hypertrophy of the posterior segment i.e. the tarsal section and the heel is necessary, as also the inclination of the heel downwards and backwards. During stance the weight of the body is transmitted by the tibia to the top of the arch and is distributed in equal proportions between the heel and the metatarsal heads. During locomotion—at the stage of lifting the heel from the grounds and swinging the other leg forwards—all the weight is transferred to the metatarsal heads, especially the first two thereby putting a strain on them and on the arch. The contractural tone of the leg muscles now come into play and takes off some of the strain and thus relieves the arch.

The second example of gait may be considered comparable with the early stages of leverage development and a low arch—as we find in the gorilla. Evidently the first propulsive efforts in this ancient ground-dweller were weak and associated with a shifting of weight from one foot to the other. Continued exercise in a group of active and energetic animals however, would stimulate the development of leverage action with a subsequent lengthening and inclination of the heel.

The purpose of this brief review of the skeletal characteristics of the primate feet including those of the anthropoid apes is to show in these animals, as they ascend in the primate scale, the gradual development of those features which are peculiar to the human feet. It has been said that man arose from a stock which separated from the common ape stock in the oligocene period perhaps 2,000,000 years ago. But even so, one is struck by the close resemblances between the foot of the gorilla (which is the highest developed anthropoid) and the human foot and what differences there are, are probably due to the latter's longer terrestrial existence and longer bipedal mode of locomotion. The differences be-

tween the primate and the human feet may be summarised as follows:—

#### PRIMATE FOOT

- (1) The long digital and metatarsal segments.
- (2) The wide abduction of the great toe—the wide range of its movements and the possibility of its adduction to the other toes.
- (3) The torsion of all the metatarsal shafts including the first—that of the first being in opposite direction to the outer four.
- (4) Along with the lateral torsion there is plantar curvature of the metatarsal shafts and phalanges.
- (5) Compared with the metatarsals, the tarsal bones are short and insignificant. This is especially so in the case of the os calcis whose tuberosity is rudimentary and directed horizontally.
- (6) There is no arch except its very primitive appearance in the foot of the gorilla.

The first four characteristics reveal the presence of an anterior clasping arch in these primate feet which is so very necessary for the arboreal existence of these animals. The mode of regression of this anterior clasping arch can be read from the formation and arrangement of the human metatarsal and toes. "The metatarsal bones and basal phalanges show, although to a varying degree, the original bend towards the plantar aspect of the foot. The rotation of the metatarsals is also evident; these are clearly twisted in their capitulum when compared with their basal parts and this in such a way that the capitulum of the metatarsals 2 to 4 point medially while the metatarsal 1 behaves exactly in the opposite way pointing laterally." (Wiedenrich—1923).

The longitudinal arch is the latest acquisition in the foot of the higher primates. As

has been stated before, it is the result of upright stance and progression and is brought into being by the leverage effort of terrestrial locomotion. Owing to the upright posture of the animal, the centre of gravity has shifted backwards and to this is added the necessity of obtaining good leverage in weight bearing feet. The upright posture causes the large calf muscles to pull strongly upwards and a great weight of leverage is required of the ankle joint. By Wolff's law, bone would be formed in the proper place and to the extent necessary to resist the stress it encounters and the os calcis therefore is prolonged downwards and backwards to resist the great additional weight thrown on it in walking. The prolongation of the os calcis produces the heel and is the most important factor in the appearance of the longitudinal arch. The longitudinal arch is present in the foot of the gorilla in a primitive form. It is conceivable that if the gorilla continues to exist for some hundreds of years and to practice bipedal upright locomotion without the support of its hand—the arch in its feet would partake of human characteristics in their entirety.

It has been noted in the few incomplete parts of the human fossil skeletons (which have been discovered till now), that the principal characteristics of the different constituents of the foot and especially of the arch remain the same as in recent man—(Wiedenrich—1933). The conclusion therefore seems justified that these fossil hominidae must have walked upright.

One other conclusion seems to justify itself if we examine the stages of development of the primate foot, and compare them with the development of the foot in the foetus and in infants and children upto the adult stage. In both instances, one is struck with the close similarity of progress to the adult human type. Thus the shortening of the fore part of the foot, the increase in length and strength of the tarsal section, the increasing development of the first metatarsal and its abduction and fixation to

the other metatarsals, the gradual importance of the medial side of the foot and the culmination of all this, the appearance and development of the longitudinal arch of the foot, are common in both instances. One can say therefore that in this respect ontogeny has recapitulated phylogeny.

### SUMMARY AND CONCLUSION

The antagonistic view points between the two schools of thought as regards the rigidity and permanence of the longitudinal arch of the foot have been mentioned. To the school to which Bankart, Wiles and others belong, the normal feet should be perfectly supple and capable of altering the height and the shape of its arch at will. The apparent rigidity and the unyielding arch seen in human foot is ascribed by them to be due to the result of constant use of unyielding foot wear and they consider this as an abnormality. The other school which includes Lake, Morton and others consider the want of suppleness in adult human feet as perfectly normal and as Lake puts it "the evolutionary destiny of the human foot is to the production of a rigid structure having an arched form but devoid of any movement other than those at the ankle and the toe joints."

From my investigations I am inclined to the latter of the two views. I have found that there is no difference so far as rigidity and inelasticity is concerned between the feet of bare footed people and those who wear shoes continually. I have further shown that the feet of those who wear shoes continually show a peculiar characteristic as regards the arch. There is on the average a slight lowering of the arch and some abduction of the fore part of the foot.

My investigations have further shown that the postural tone of the antigravity muscles are not responsible for the maintenance of the arch. There is acute difference of opinion as regards this point between the same two schools of thought. I have shown that the abolition of postural tone has not the slightest effect on the arch—that under

those conditions in which the postural tone might be expected to be diminished or absent, the arch remains unaltered, and that in babies and infants in whom the postural tone is said to be absent and in whom the arch has seemingly not developed, the apparent absence of the arch is due really to the well developed pad of fat and the excessive amount of soft tissues which hides the arch.

I have further shown that the real factors in the maintenance of the arch is the bony configuration of the medial side of the foot and the strong ligaments binding the bony frame work. Loss of this ligamentous influence causes more or less depression of the arch. The muscles at best are of secondary help in taking off some of the strain during locomotion.

I have pointed out the gradual stages by which the arch appears in children's feet and have shown that the full development of the arch is not complete before the 6th year.

I have dissected a series of foetuses' feet—the smallest being of 28 mm. C.R. length and have shown that the cartilaginous frame work of the arch is evident from that stage or even before. I have also made a series of comparisons as regards the different constituent elements of the feet in these embryos and have shown that throughout foetal life there is a progressive diminution of the digital and metatarsal elements of the foot and increase of the tarsal elements and the heel. The same is true for the infants and the children's feet as they increase in years and the same changes continue until adult proportions are reached. I have also examined the skeleton of the foot of some of the primate animals—a few of the lower primates and most of the higher primates and I have pointed out their individuals characteristics. I have shown how these characteristics vary with the mode of living of these animals, their habitat and their manner of locomotion. It was seen that as these animals discarded their arboreal existence and took to terres-

trial abodes, their feet exhibited certain characteristics akin to those in human feet. As the animals adopted the upright posture (as in the gorilla) the resemblance became still closer—the heel became prominent, the tarsal section increased in length and the abduction and the torsion of the great toe decreased and it increased in strength and prominence. It has been said also that the longitudinal arch manifested itself in the gorilla foot.

From all these considerations, it can be concluded that the longitudinal arch of the foot in its fully developed state is a human characteristic — permanent and rigid — brought into being according to the tenets of Wolff's law—because of man's terrestrial habits and upright posture. For the appearance of the arch, the increase in the size of the heel, its inclination, the increase in the tarsal section of the foot, the diminution of its fore part and the increased strength of the medial side of the foot are responsible; for its maintenance the bony configuration and the ligamentous support are the important factors. The contractural tone of the muscles may be of some help during locomotion but the postural tone is ineffective.

### WRITER'S CONTRIBUTION

1. A critical study of the foot prints of barefooted people and those who wear shoes continually pointing out the difference between them as regards the lowering of the arch of the foot and the abduction of its forepart in the latter class.

2. A series of examinations in which the influence of the postural tone of the muscles on the arch of the foot was determined.

3. Experiments illustrating the influence of the ligaments in the maintenance of the arch of the foot.

4. A series of examinations showing the gradual development of the arch of the foot from birth up to the age of 8 years.

5. Embryological investigation of the foetuses' feet upto the stage of 28 mm. C.R.

length pointing out the presence of the cartilaginous frame work of the arch.

6. It was determined by comparison of the different constituent elements of the foetal feet with those of the adult feet, that, as the feet increased in length, the different constituent elements underwent changes which corresponded with those in primate feet as they developed into higher stages.

7. Measurements of the heights of soft tissues in foetal and infant feet at different levels and their comparison with those in adult feet showed how the arch is hidden by the excessive soft tissue element in the former.

8. Examination of the skeleton of the foot of several of the lower and higher primate animals and their comparison with the human foot as regards the different constituents of the foot and the longitudinal arch.

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# URETER TRANSPLANTATION IN CANCER OF THE BLADDER

by N. D. LAKHANI.

## *Preamble*

Malignant disease of the urinary bladder remains a formidable proposition to-day. The role of radiotherapy as a palliative measure of limited value is generally recognised now. At a comparatively recent meeting of the urological section of the Royal Society in London, urologists and radiosurgeons reviewed their experiences in bladder cancer. Pure radiotherapists were also present. It was generally accepted that radiotherapy whatever the mode of application, has proved itself to be a complete failure and the only possible hope for cure, with our present and incomplete knowledge of cancer, lies in radical cystectomy in the female and cystovesiculoprostatectomy in the male. This conclusion has been a great incentive in the choice of this paper, as it is only by making the preliminary ureter transplantation a success that radical extirpation of the disease can be anticipated.

The implantation of the ureter into another part of the bladder (ureteroneocystostomy) may be suitable for the rare case of localised vesical cancer situated in the vault of the bladder. The ultimate results of partial and hemicystectomy are so poor that any surgical intervention for bladder cancer should aim at nothing else than a radical cystectomy. The situation is comparable to the choice between a radical mastectomy or local removal of the lump for a malignant condition of the breast.

Deviation of the ureters in the loins and on the anterolateral aspects of the abdominal wall have been practised by Henry Wade and others. The technique of the operation is simple and the urine can be collected in rubber reservoirs. The discomfort to the patient is the same as after a nephrostomy and with increasing experi-

ence, the Edinburgh school has turned in favour of ureterocolic implantation.

Transplantation of the ureter in various parts of the large intestine has been tried by many workers. Makkas suggested the caecum as the new bladder and performed rather a complicated operation for the purpose. Sampson Handley transplanted it directly into the caecum but absorption of the nitrogenous constituents of urine from the large intestine eventually proved fatal. In a case operated upon recently with which I was concerned, this site was used (patient with imperforate anus, colostomy and pathological fixation of the colon) and she died of typical uraemia during the first week after the operation. Transplantation of the ureter in the pelvic colon is well tolerated by the animal economy. The colonic mucous membrane being developed from the entoderm appears to be designed by nature to take over the reservoir function of the bladder and get readily adapted to this new urinous environment. This embryological fact and the clinical successes attendant upon this deviation of urine explain the current trend of surgeons all the world over towards ureterocolic method of transplantation. The scope of this paper is confined to this method.

## *Evolution of the operations*

In 1851, John Simon, then surgeon to St. Thomas' Hospital, transplanted the ureter into the rectum. This was a bold undertaking in those days, when even the removal of a sebaceous cyst was apt to be followed by erysipelas and prove fatal. Pasteur and Lister were still to expound their discoveries on fermentation and antiseptics in the next decade. The year 1870 may be regarded as the pivotal point in the second half of the nineteenth century. The Franco-Prussian War gave opportunities to test out the Listerian hypotheses. Surgery marched one step forward and men like Sir

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The author is grateful to Prof. Grey Turner for guidance and encouragement given for this study.



Thomas Smith (1878), Chaput (1894), Trendelenburg (1895), Tuffier and Chalot (1896), and others interested themselves in this branch of surgery and laid down the foundations for future work.

The failures following these operations were too numerous and the operative mortality appallingly high. It was precisely these failures and a critical analysis of them that revealed the dangers associated with the operations, stimulated the methods for safeguards and lowered the mortality of nearly a 100% to the present average figure of 30—35%. These pioneers opened new paths for further investigations in this and related fields of experimental surgery.

The names of Sir Harold Stiles and Coffey are intimately associated with the ureterocolic operations and the work on the lines chalked out by them is carried on by men like Grey Turner, Clifford Morson, Bernard Ward, Jewett, Cabot, Priestley, Strom and many others.

Experimental work has been carried out chiefly on dogs. The canine rectum is straight and very suitable for such experimental purposes. The principles of the modern operation described later in some detail are derived from a co-ordinated synthesis of these experimental and the post-mortem findings in the human subject. Animals surviving the operations show manifestations of recurrent ascending urinary infections, hydronephrosis and urinary calculi.

#### *Arterial supply of the pelvic ureter*

In the majority of specimens specially injected to demonstrate this, the injection mass from the internal iliac artery is visible in the periureteral vessels up to the point of bifurcation of the common iliac. This represents the supply to the terminal 4 inches of the ureter. The distribution occurs via the superior vesical and middle haemorrhoidal arteries. It is interesting to observe an accessory short but constant ureteral branch arising from the superior

vesical near its origin. These vessels course downwards along the ureter from the pelvic brim to the vesical end, the upper 2½ inches of this course being reinforced by tributaries from the internal spermatic artery. This anatomical fact explains why, with ordinary care the blood supply of the transplant is satisfactory.

Very occasionally, however, the principal vessels join the ureter at the vesical end and ascend upwards and in such circumstances, they would be damaged during the division of the ureter, with sloughing and peritonitis as the invariable sequelae. Fatal outcomes in such cases have shown that the necrosis is confined to the terminal 1½ inches. Should such an anomaly be suspected during the operation, this part should be excised and the transplant made at a higher level than usual.

#### *Principles of the main operations*

Simon brought about a fistulous communication between the ureter and the rectum by a tight ligature introduced with the help of an ingenious device. The patient who survived the operation for a time, died of ascending urinary infection and calculi. The rectum appears to be the ideal site for transplantation but is far too low to satisfy the modern requirements for the successful performance of the operation.

Smith used the posterior aspects of the ascending and the descending colon, doing the operation in stages. The subsequent post-mortem findings of the recorded case show that the left ureter, which was first transplanted, was obliterated by scar tissue; the left kidney was atrophied and the immediate cause of death was uraemia resulting from compression of the right ureter by sutures. The method never received any encouragement.

Trendelenburg laid stress on the importance of ascending urinary infection and he utilised a part of the bladder wall to provide a valvular mechanism.

Cuneo transplanted the ureter in an isolated loop of the ileum, of which the

mesentery was intact. One end of this ileal loop was closed and the other was anastomosed to the rectum.

The Makkas principle was illustrated in an attempt to produce an entirely new and independant urinary bladder, with blood supply, innervation and voluntary control. The caecum was isolated from the ascending colon and terminal ileum by division and an ileocolostomy was performed. The operation ended with an appendicostomy and the caecal cul-de-sac was rendered as sterile as possible by repeated irrigations through the fistula. The ureters were then transplanted in the caecum.

The lessons from these different operations clearly pointed to the lower part of the large intestine as the most convenient site for future attempts and brought home that ascending urinary infection and peritonitis were the real formidable risks and must be prevented in future.

The operations devised by Stiles and Coffey take these factors fully into account and by a combination of the Stiles-Coffey principles, the margin of safety becomes wide and the operation which belonged to the realm of special urology, can now be handed over with safety to the general surgeon, after the lapse of nearly a century of trial and error.

*Stiles' operation* : This was introduced in 1907. The divided end of the ureter was brought into the lumen of the pelvic colon through a transverse incision in the taenia and anchored half an inch below this point by fixation sutures passed through the bowel from within outwards. The site of the bowel incision was invaginated by a series of purse-string sutures, producing a Kader-Senn effect. Stiles paid meticulous attention to the fixation of the ureter but none at all to the provision of effective drainage into the bowel.

The traditions of the English Royal College of Surgeons are centred round the teachings of John Hunter, and one of these which has become classical is: "Living

matter by itself has mastered the art of healing; if men are to become surgeons, they must learn their art by studying the surgical ways of living matter." Grey Turner who was a great student of Hunter and later destined to deliver the Hunterian Oration of the College, pondering over our problems in the light of the above aphorism, suggested that if the ureter were brought with an obliquity into the bowel, as it emerged from the posterior abdominal wall, extrinsic obstruction would be eliminated and better drainage to the flow of urine would be provided for. Stiles incorporated this in his technique and buried about one inch of the ureter on the surface of the bowel wall by interrupted sero-muscular sutures, the principle employed now being that of Witzel for gastrostomy and enterostomy.

Charles Mayo improved upon this by introducing a catgut guide in the lumen of the ureter to overcome the effect of obstructive oedema.

*Coffey's operations* : To reduce the risks of ascending urinary infection and obstructive uraemia to the minimum, Coffey laid the ureter in an oblique fashion as Grey Turner suggested but secured additional safety against peritonitis and a valvular effect, by making a submucous bed in the bowel.

In the early twenties of the century the two ureters were operated upon in stages. This meant loss of time, so invaluable in malignant disease. Coffey was not satisfied with Mayo's catgut guide as a guarantee against possible effects of oedema and improved upon his technique by introduction of a catheter in the ureter at the time of operation, now doing both the ureters simultaneously (1925). He combined this with colonic lavage before and during the operation and considered this as the secret of the improvement in results. The actual operation may be epitomised thus. Rubber tubes or catheters are introduced 15 cms. up the ureters and held in position by stitches. A sigmoidoscope is introduced on the ope-

rating table and the bowel is washed and packed with sterile ribbon gauze. The pelvic colon is now opened in the usual oblique manner and the mucosa in the lower part of the bowel wound is incised. A knuckle of gauze packing is brought out and the ends of the catheters are anchored to this. When the gauze is pulled out, the ends of the catheters emerge at the anus externally. The catheters become loose in 10—12 days and could be easily removed. Should, however, these get blocked earlier by phosphatic deposit etc. the situation becomes grave and fatalities are known to occur.

Still later, Coffey devised a third method wherein he carried out the operation in stages. Here he divided the vesical end of the ureter between ligatures and laid the ureter in a submucous bed, transfixing it through the mucosa by a double thread. The thread was tied tightly in the hope that a fistulous communication would result later.

Coffey's principles are very sound and are accepted generally to-day. Surgeons of experience, however, are finding that they can now transplant both the ureters simultaneously with equally good results without the paraphernalia of tubes, catheters, sigmoidoscope etc.

#### *Routine management of a given case based on Personal Experiences*

The patient is admitted to the hospital at least ten days before the contemplated operation. Routine clinical examination of the abdomen, pelvis and the body generally for any possible metastases is carried out. Cystoscopic examination will probably need a spinal anaesthetic, as the bladder is irritable and the growth readily bleeds rendering the field haemorrhagic and opaque. Most urologists depends upon the cystoscopic appearances of the growth for diagnosis and in a typical case this would be ulcerated, sessile, covered over with phosphatic incrustation, causing infiltration of the adjacent bladder wall and generalised cystitis. The tendency for the lesion

to bleed after cystoscopy confirms its malignant nature. Biopsy as a diagnostic measure in cancer of the bladder is not popular beyond the U.S.A. The late Swift Joly and his colleagues at St. Peter's Hospital found such biopsy to be of very little value. Examination of the urine, blood chemistry, blood group, intravenous pyelography and plain X-Ray of the chest (sometimes demonstrating unsuspected secondaries) and of doubtful osseous lesions cover pretty well the routine accessory investigations. On rare occasions where a pyonephrosis is suspected ureteral catheterisation may be resorted to.

During this period the renal function is brought to the optimum level and a urinary output of 75-80 ozs. per day in cold climates such as that of England may be regarded as satisfactory. The most reliable single index of renal function is the figure for the 24-hour output. If this is poor (below 50 ozs.) or there is a co-existent pyonephrosis, a preliminary nephrostomy is indicated. I can well remember a lady so treated celebrating her eightieth birthday in the hospital while awaiting her discharge after total cystectomy.

Immediate preoperative preparation consists in the administration of one ounce of castor oil forty-eight hours before operation and an enema on the night before. This special preparation diminishes the troubles associated with distension of the bowel during and after operation.

Frequent bladder washes are unnecessary except in cases with severe haematuria.

General care is directed towards adequate nutrition and correction of existing anaemia. Use of sulphonamide group of drugs to counteract urinary infection is reserved for the postoperative phase and in this respect resembles the use of quinidine for toxic goitre cases after subtotal thyroidectomy. Some degree of cystitis is nearly always present but is not of any great moment. The fearful complication of

ascending urinary infection from the bowel is best prevented by adequate operative technique and diuresis, and little reliance should be placed on drugs or bladder washes.

*Some features in the operation:* Whatever the actual technique employed, all are agreed that the following criteria should be fulfilled. (1) Provision of good drainage for the urine to flow from the kidney to the bowel, this being achieved by avoidance of ureteral compression, angulation and stomal oedema. Ascending urinary infection does not occur in cases where drainage is good and taking place all the time, (2) absence of tension at the site of anastomosis and (3) preservation of the blood supply of the ureter to prevent sloughing and peritonitis. Two important questions have to be considered before the actual operation. These are: (1) Should the two ureters be dealt with at the same time? and (2) Which is the best site in the pelvic colon for our purpose? With experience, the operative mortality consequent on a bilateral operation is not increased. The performance of the operation does not take more than an hour and a half at the most and we are saving valuable time for the more important second event of total cystectomy. The right ureter is transplanted first and the left afterwards at a higher level. The sites generally chosen in the pelvic colon are  $2\frac{1}{2}$  and 4 inches above the pouch of Douglas for the right and left ureter respectively. Both the ureters are transplanted on the same side of the bowel viz. the right side and for this purpose the left ureter would have to be negotiated through the pelvic mesocolon. These are general observations and in any given case the site should be such as would enable the ureters to lie snugly at the conclusion of the operation.

The following are the main points in the actual procedure:

1. Catheterisation of the bladder on the operating table before the commencement of the operation.

2. Exploration of the abdomen by a midline incision extending from the umbilicus to the pubis. Search should be made for secondaries in the liver, peritoneum and lymph nodes in the pelvis. The presence of growth in the bladder is verified and its situation and local extensions noted. The local or general spread of the disease does not deter us in any way from carrying out the operation, if the general condition of the patient and the renal function are satisfactory. Indeed, the relief of vesical pain and frequency of micturition following the operation is very remarkable.

3. A moderately high Trendelenburg position is given and large gauze packs are introduced to keep the small intestines out of the way. An incision is now made in the posterior parietal peritoneum over the site of the ureter below the pelvic brim as it crosses the internal iliac artery. The ureter is isolated for a distance of  $2\frac{1}{2}$  inches, taking great care of the blood vessels. When so exposed, it may show vermiculation, and a certain amount of dilatation, not infrequently.

It is divided  $\frac{1}{2}$  inch proximal to the bladder and the vesical end is ligatured and carbolised. The proximal side is held aside by a long strand of catgut.

A two inch incision is now made obliquely in the bowel down to the submucosa and the mucous membrane in the lowest part of of the intestinal wound is opened. The end of the ureter is brought through this and anchored half an inch below in the way suggested by Stiles. Mayo's catgut guide is not generally used now. The rest of the ureter is laid in the oblique submucous bed which is closed over it in two layers of interrupted sutures, the first bringing the muscular coats together and the second being in the Lembert style. Some of these are left long to anchor the bowel to the posterior abdominal wall. The incision over the course of the ureter is closed so as to render it extraperitoneal to the point of anastomosis.

Dusting of the wound with sulphonamide powder and insertion of a drain in the neighbourhood are entirely unnecessary.

Closure of the parietes is carried out with great care. The risk of bursting of the wound is a real one.

At the conclusion of the operation, a self-retaining catheter is introduced in the rectum and held in position by stitches through the perianal skin for 24-36 hours.

**Postoperative care:** General care of the patient should be on the lines as after any laparotomy. Deaths from pneumonia, pulmonary embolism, acute dilatation of the stomach and paralytic ileus have all been reported and met with by me. I must record one death caused by pneumonia, superimposed upon clinically unrecognised metastases in the lungs. Another patient who seemed to be getting on satisfactorily died on the fifth day of massive pulmonary embolism confirmed at autopsy.

It is most important to see that the urinary output is steadily kept up. To the patients and nursing staff are explained how important adequate fluid intake is in the management of such cases and with their cooperation, the postoperative phase becomes smooth. As a rule, diuresis gets established in twelve hours and this being involuntary at first results in leakage by the side of the tube and bed-wetting. A rubber bedpan is very helpful to these cases. The output steadily rises to 75-80 ozs. per day in the next two or three days. The success of the whole affair depends on team-work. If the renal function is not satisfactory after twelve hours in spite of all the care, an intravenous drip is set up at once and an administration of five pints of fluid every twentyfour hours is carried on. We avoided chloride retention and resulting tissue and specially pulmonary oedema by alternating one pint of normal saline with four of 5% glucose in distilled water. This could be carried on for as long as a week. Although a digression, I would like to state that the most striking results

of such a prolonged administration were seen in an unconscious patient with uraemia caused by prostatic hyperplasia. The intravenous fluid therapy should be combined with the subcutaneous injection of 1/200 grain of digitalin. The effect of this on the renal tubules appears to be specific—almost a potentiation in the pharmacological sense of the word. Some urologists put their patients straightaway on sodium sulphate drip at the conclusion of the operation. In such a series of 13 cases, Morson and Graham reported a mortality of 5 cases, i.e. 39%. This and the demonstration of occasional deaths resulting from the prolonged use of this drug indicate its place in the selected few cases where other and more physiological methods have failed and we used it only in a few cases.

When the rectal tube is removed, the patient gradually develops control over this new mode of micturition and in about six weeks, he has a fairly good control.

I cannot recall a single case of peritonitis (in a series of twenty cases on which this paper is based) after this operation. Abdominal pain, localised tenderness, rigidity and pulse charts are carefully watched from this point of view.

#### *Follow-up of the cases*

The immediate results of ureter transplantation are encouraging, even in cases where radical cystectomy is not contemplated. The striking improvement of pain and frequency restore the patient to a state of normality, at least for a few months. One of our youngish patients (aged 45) contemplated marriage after discharge. Unhappily radical operation was out of the question in his case owing to local extension of the disease and involvement of the superficial glands in the right groin.

These patients get used to the rectal micturition every 2-3-4 hours, the interval varying in each case within these limits generally. The pelvic colon appears to be the new reservoir, for it is here that the urine is seen accumulated after intravenous

pyelographies. Frequency, incontinence, recurrent attacks of mild pyelitis, pain due to hydronephroses and urinary calculi are some of the clinical features in the after histories of these cases and one or the other of these may be the source of further annoyance.

The mortality following the operation varies considerably, the average being 30-35%. Priestley and Strom in an excellent series of 51 cases reported a mortality of 15.7%.

To surgeons interested in ending the sad story of malignant disease, Shakespeare's immortal words through Hamlet should be a constant inspiration.

To be or not to be, that is the question :  
Whether 'tis nobler in the mind' to  
suffer

The slings and arrows of outrageous  
Fortune,

Or to take up arms against a sea of  
troubles,

And by opposing, end them ?

# BACTERIAL FLORA OF EAR PUS IN SOUTH INDIANS

by R. ANANTHANARAYANAN.

The suppurating ear has been a problem in the army. It has been a cause of considerable decategorisation and invaliding. This malady is no less common in civil life. In the Govt. Stanley Hospital, E. N. T. Department, out of 1412 new cases in December 1947, 451 were cases suffering from suppurating ear i.e. 31.94%. In this paper an attempt is made to study the bacterial flora of ear pus. The material was taken from the patients attending the E. N. T. Out-patients' Dept. of the Stanley Hospital.

The study was done in three parts. (1) The bacterial flora of the normal ear (external ear) of 60 hospital class of people were studied. The specimens were taken from the donors who attended the Stanley Hospital Blood Bank. A sterile swab dipped in sterile glucose broth was used to swab out the ears of such of those who gave no history of ear troubles. An auroscopy was done in each ear to make certain that it was not a pathological ear. In each case a direct smear and cultures on glucose broth, serum agar, Douglas agar, inspissated serum and D.E.C. medium were studied. In the first fifteen cases, cultures on glucose agar tubes were put up for fungi. No fungi were grown. The following table gives the flora met with :—

Name of Organism	Percentage
1. Staphylococcus Albus ..	91.60 %
2. " Aureus ..	3.33 %
3. " Citreus ..	13.33 %
4. Chromogenic Cocci (Brick Red & Red) ..	5.00 %
5. Gaffkya Tetragena ..	6.00 %
6. Diphtheroids ..	30.00 %
7. Spore bearers Aerobic ..	70.00 %
8. B. Pyocyaneus ..	1.67 %
9. Yeast Cells ..	18.33 %
10. Vincents Spirochaetes ..	1.67 %
11. Fusiform Bacilli ..	1.67 %
12. Enterococci ..	1.67 %

(2) The bacterial flora of the normal oropharynx was studied in twenty cases. Swabs were taken from normal oropharynx by Dr. T. Nandagopal, Hon. Asst. Surgeon, E. N. T. Department, Stanley Hospital and sent to me. The flora were as given below :—

Name of Organism	Percentage
1. Staphylococcus Albus ..	85.00 %
2. Gaffkya Tetragena ..	5.00 %
3. Streptococcus Non-Haemolyticus ..	100.00 %
4. Pneumococci ..	20.00 %
5. Diphtheroids ..	60.00 %
6. Vincents Spirochaetes ..	5.00 %
7. Organisms morphologically resembling C. Diphtheriae ..	5.00 %

(3) Swabs of pus from 100 ears were sent by the E. N. T. Department for this investigation. A direct smear and cultures on Douglas agar, serum agar, glucose broth, blood smeared agar, inspissated serum, Tellurite medium and D.E.C. medium were studied:

Name of Organism	Percentage
1. Staphylococcus Aureus ..	71.00 %
2. " Albus ..	5.00 %
3. Gaffkya Tetragena ..	3.00 %
4. Streptococci ..	39.00 %
5. Diphtheroids ..	66.00 %
6. Organisms morphologically resembling C. Diphtheriae ..	21.00 %
7. Vincents Spirochaetes ..	26.00 %
8. Fusiform Bacilli ..	28.00 %
9. B. Pyocyaneus ..	34.00 %
10. B. Coli ..	7.00 %
11. B. Proteus ..	18.00 %
12. B. Asiaticus ..	2.00 %
13. B. Morgan ..	1.00 %
14. B. Lactis Aerogenes ..	1.00 %
15. M. Tuberculosis ..	1.00 %
16. Yeast Cells ..	2.00 %
17. Spore bearers (Aerobic) ..	14.00 %

The author is indebted to Drs. P. S. Natesan, T. Nandagopal and Sundararajan of Stanley College and Hospital for advice and help.

This study was stimulated by the varied flora of ear pus which I came across

on routine investigation. The class of people from whom swabs were taken in Part (1) forms more or less a cross section of society: doctors, technicians, laboratory workers, labourers, carpenters, drivers, ward-boys, mechanics, bakers, rhyots, painters, etc. The normal flora of the external ear, and oropharynx—as an alternative to the normal Eustachian tube—were studied as they form the gateways to the middle ear.

The investigations showed that (i) Vincent's infection of the ear is much more common than believed, viz. 26%. (ii) Organisms resembling *C. Diphtheria* morphologically are fairly common, viz. 21%. (iii) *B. Pyocyaneus* is of frequent occurrence, viz. 34%. The large percentage of aerobic spore bearers is worth noting. Vincent's infection was characterised by the tendency to bleed readily, on even gentle manipulation of the infected area (Nandagopal). *Diphtheria* was never suspected but was found during routine investigation. The patient had no obvious ill effects due to this in the ear or elsewhere. A few of the strains of *C. Diphtheria* were tested for toxicity and were found to be of the *mitis*

variety. *B. Pyocyaneus* was the cause of considerable discomfort and was intractable to treatment. In the case of the ear from which *M. Tuberculosis* was seen in smears and grown in cultures, the patient had *Tuberculosis* of the Lungs for which he had been treated. The presence of *B. Proteus*, *B. Coli*, etc. is probably due to unclean personal habits. All the strains of *Staphylococcus Aureus* isolated—except where they were occurring in conjunction with *B. Pyocyaneus*—were tested for coagulase and haemolytic power. They were positive for both. No study was done on the haemolytic power of *Streptococci*.

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## CASES & COMMENTS

### MULTIPLE MYELOMA — A CASE REPORT\*

by C. RAGHAVACHARI.

Cases of multiple myelomata are rare, and further the case reported here shows several unusual features worthy of recording. The features of a typical case of multiple myeloma were understood to be—incidence in later age periods, multiple lesions in flat bones, tendency to pathological fracture, radiological features of punched out areas, urine changes and ultimate fatal end. There are a number of features in which the case under report differs from the typical. Recent reviews of series of proved cases of multiple myeloma have brought out the typical and some of the atypical features of this disease. *Chormley and Pollock*<sup>1</sup> have reviewed a series of 86 cases detected during 1924—36 at the Mayo Clinic stressing the features of the disease and calling particular attention to the diagnostic difficulties in early cases. There is another review of 83 cases by *Bayrd and Heck*<sup>2</sup> who also stress the varied clinical and laboratory features of this disease. The case under report was under observation for 8½ years making it possible for a detailed study and follow up of the case.

#### CASE REPORT

The patient Kandaswamy, Hindu, male, 17 years, was admitted on 27-9-1938 for multiple unsightly protuberances on the forehead, face, chest, etc., of six months' duration.

Personal history: There was no history of syphilis or of trauma.

History of onset: The patient noticed lumps appearing in his forehead, face, etc., after taking some indigenous medicine for stiff joints 6 months previously. The onset was afebrile. They appeared in the following order:—Right forehead, left side of forehead, above the eye brows, over the face and then over collar bones.

Condition on admission: General condition fair; not anaemic; afebrile. Facies resembled that of

leontiasis ossea (Fig. 1). There was no exophthalmos; there was no swelling in the neck. Abdomen: showed no appreciable disease. Genitals were normal. There was no lymph-adenopathy.

Local condition: There were twenty lumps distributed over the following regions:—

*Head*: Right & left frontal regions, right frontoparietal region, right & left supraorbital margin and left maxilla.

*Trunk*: Middle of right & left clavicle; manubrium and body of sternum and ninth rib.

*Extremities*: Lower ends of right & left humerus, lower third of right ulna, right & left metatarsal base, over the tibial tubercle, over the prominence of the left heel and bases of the first and second metatarsal.

The lumps varied in size from nodules of ¾" diameter to elongated masses 2" and ½" broad. They were of different degrees of hardness, all fixed to bone, some tender but none warm to touch. Skin was freely movable over swellings. There were no prominent veins. Those over flat bones were rounded, while those over the ends of long bones were fusiform.

Examination per rectum: no appreciable disease.

#### INVESTIGATIONS

##### I. Urine:

No albumin. No sugar. No Bence Jones protein. Deposit: Nil. Output normal. Intravenous pycnography: nil abnormal.

##### II. Blood:

R.B.C. 4.5 million/c.m.m. Hb. 75% (Zeiss).  
W.B.C. 10,000/c.m.m. P-45% L-15% M-2% E-39%  
Kahn Reaction—Negative.  
Blood Sugar (fasting)—100 mgm %  
Blood urea—30 mgm %  
Serum Calcium—10 mgm %  
Serum Phosphorus—3 mgm %  
Plasma Cholesterol—180 mgm %

##### III. Skiagraphic Findings:

Skull: Punched out areas of rarefaction. A large irregular area of rarefaction with well defined margins. Geographical design of skull. Fluffiness of external table over parietal region. Periosteum appears lifted. Upper and lower jaws show areas of bone destruction. Figs. 3 and 4.

\*From the Department of Surgery, Stanley Medical College. The author is grateful to the late Dr. Bhaskara Menon, to the late Dr. Sundaresh and to Dr. Natarajan for valuable help rendered.



Fig. 1.

Clinical Photo. October 1938. A.P. view showing lesions in forehead.



Fig. 2.

Clinical Photo. October 1938. Lateral view showing lesions in forehead.





Fig. 3.  
A.P. view of skull showing lesions.



Fig. 4.  
Lateral view of skull showing punched out areas  
and a 'geographical design' in one area.

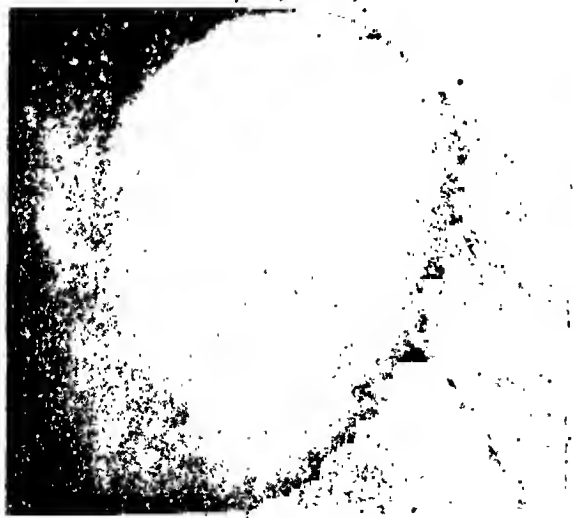


Fig. 3-a.  
A.P. view of skull after the course of deep  
X-Ray showing complete bone reformation.



Fig. 4-a.  
Lateral view of skull after the course of deep  
X-Ray showing complete bone reformation.



Fig. 5.

X-Ray of chest showing the ghost-like appearance of sternum.

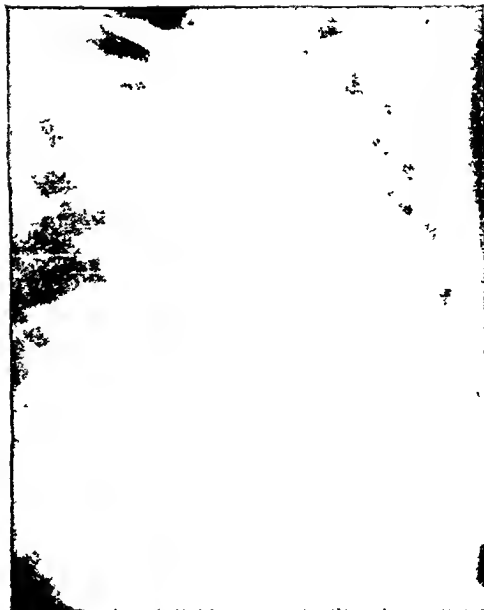


Fig. 5-a.

X-Ray of chest showing complete reformation of sternum after deep X-Ray therapy.



Fig. 6.

X-Ray of forearm showing a typical rarefied area near the end of ulna.



Fig. 6-a.

X-Ray of forearm showing the same lesion after deep X-Ray.

Note.—A biopsy has been done at this site.



Fig. 7.

Lesion in tibia—showing sub-periosteal new formation. Note that appearance is like that of osteogenic sarcoma.



Fig. 7-a.

Same lesion as above showing consolidation after deep X-Ray.



Fig. 8.

X-Ray of right patella showing a fresh lesion.



Fig. 8-a.

X-Ray of right patella after the course of deep X-Ray.

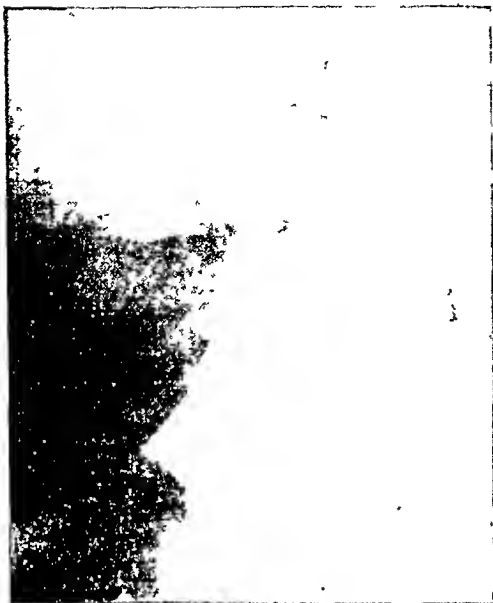


Fig. 9.

X-Ray of right patella showing a recurrence some time after deep X-Ray exposure. Note the appearance is like that of osteoclastoma.

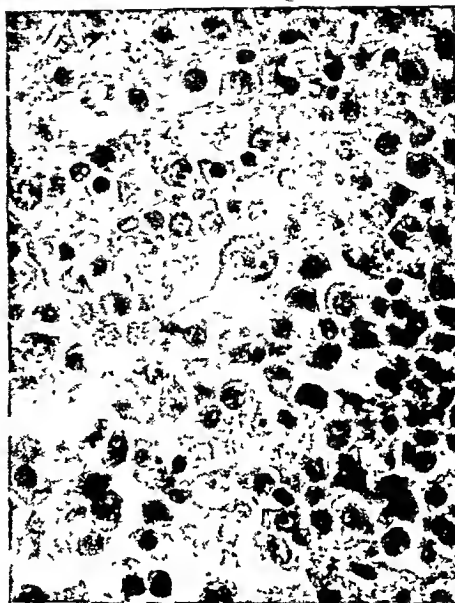


Fig. 10.

Microphotograph—biopsy of excised right patella—multiple myeloma of plasmacytoma type—shows a giant plasma cell and other plasma cells with condensed dark staining nuclei and also cells with more open cartwheel nuclei.

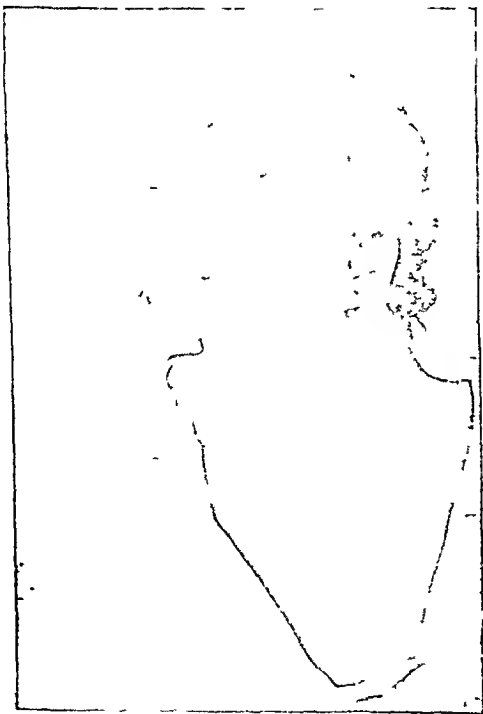


Fig. 11.

Clinical Photo—January 1945 Showing lesion in temporal bone.

Trunk: Moth eaten appearance of the affected areas of clavicle and rib. Sternum presented a ghostlike appearance. Fig. 5.

Long Bones: Sites of affection near the ends. Elongated areas of bone rarefaction; slight expansion of shaft. The spine, pelvis and femora were free. Fig. 6.

#### IV. Biopsy:

Two specimens—one from the swelling from the skull and another from the swelling from the ulna. Report:—No evidence of lipoidladen-cells or myelomatous infiltration; but thinned out poorly calcified trabeculae and wide Haversian canals occupied by chronic inflammatory fibrous tissue. Re-examination revealed opened up trabeculae occupied by proliferated fusiform cells in columns—fibroblasts

#### TREATMENT

A course of deep X-Ray therapy was instituted. The swellings retrogressed in size and such as were painful became painless. Later skiagrams showed replacement of rarefied areas by new bone formation and consolidation. The reformation of sternum is particularly noteworthy. The complete reformation shows response to deep X-Ray therapy. Fig 1-a, 2-a, 3-a, 4-a, 5-a, 6-a.

Patient was re-admitted in August 1941 for a bony swelling in the right tibia. X-Ray picture

was very much like that of osteosarcoma. Deep X-Ray therapy was given. Tumour subsided and patient was discharged. Fig. 7 and 7-a.

On 8th November 1942, patient was again admitted with irregular fever and a tumour in the right patella. Biopsy was done; with no fresh information. Deep X-Ray therapy was given. X-Rays: Figs. 8 and 8-a. Patient was discharged on 8-2-1943.

On 31-4-43 patient was admitted again for recurrence of the tumour in the right patella. X-Rays: Note that X-Ray shows a radiological picture which resembles that of Osteoclastoma. Fig. 9.

Operation: Excision of patella was done more with a view to get material for Biopsy. Post-operative: Wound healed by first intention. Full range of knee movement returned. Patella was sent for pathological examination.

Report: Multiple Myelomatous lesion plasmacytoma type—Tumour showing a giant plasma cell and other plasma cells with condensed dark staining nuclei and also cells with more open cartwheel nuclei. Fig. 10.

Treatment: Deep X-Ray therapy was given, postoperatively to the region.

On 19-6-1944 patient was admitted at night time complaining of severe headache, vomiting, giddiness of one month's duration and facial asymmetry on left side and loss of taste of 2 week's duration—a typical picture of intracranial encroachment. He had an irregular swelling  $2\frac{1}{2}$ " x 1" in the left temporal region above the ear. It was soft, fluctuant, tender and not movable over bone. He had an infra-nuclear type of facial nerve paralysis on the left side with loss of taste in the anterior two-thirds of the left side of the tongue. Fig. 11.

Fundus examination and lumbar puncture showed evidence of increased intracranial pressure. A course of deep X-Ray had marvellous effect on the local lesion and the general condition and the patient was discharged on 2-2-'45 with a residual facial nerve palsy.

Patient was readmitted for the last time on 29-5-46 complaining of epistaxis and pain over left maxillary region. Ear, Nose, Throat report:—Left antrum opaque. Polypus arising from fronto ethmoidal region. Biopsy was taken. Biopsy report: Myeloma of plasma cell type.

Fundus examination: Secondary optic atrophy left; no perception of light. Urine showed Bence Jones Protein on 1-6-46. Serum Protein 7.0 Gm. R.B.C. — 3.2 mill. Hb. 70%. Patient had a course of deep X-Ray which was finished on 9-8-46. He was discharged a few days later in a bad state against medical advice and presumably died soon after.

## DISCUSSION

The case under report presents quite a number of unusual features associated with the disease. Though the patient was under observation and treatment from September 1938, the correct diagnosis was arrived at only in 1943. The negative laboratory findings, absence of Bence Jones proteinuria and the biopsy report, prevented us from correctly diagnosing the condition though it was suspected to be one of multiple myeloma from the beginning. The unusual features of the case are (a) The young age of the patient, 17 years; (b) the very long survival period ( $8\frac{1}{2}$  years), (c) the absence of lesions in the vertebra and pelvis and (d) the site of lesions in the ends of long bones, (e) the absence renal dysfunction and (f) the absence of Bence Jones proteinuria till just before the very end. There was no pathological fracture in any of the lesions. In retrospect one is inclined to blame the first biopsy—that the specimen was not taken properly. The earlier negative biopsy report is explained by "the possibility that the biopsy tapped only the periphery of the lesion. The widening of Haversian canals which are filled by fibroblasts mentioned in the first biopsy report refers to the connective tissue reaction found around any infiltrative growth." (Dr. T. Bhaskara Menon.)

At first a diagnosis of osteitis fibrosa multiplexa was made. However the patient had the benefit of deep X-Ray exposures—started on an intuitive empiricism under the direction of late Col. Mahadevan whose case it was. But for this the case might not have survived for  $8\frac{1}{2}$  years. Nor could we have come to a correct conclusion regarding the nature of the case.

Among the 86 cases reviewed by *Chormley and Pollock*, the average age of the male patient was 52 years whereas all the 53 clinically, radiologically proved cases were above 50 years. The duration of the disease from the onset of symptoms to death on the average was 26.9 months, though there was one case living for 10 years. The patient under review was 17 years only and

lived for 8½ years after the onset of symptoms. Another clinical feature that is peculiar to the case is the distribution of the lesions. There was complete absence of lesions in the vertebra and pelvis. In the Mayo Clinic series referred to above, the involvement of pelvis was 100% in one group and 72% in another group. Long bone involvement was not a common occurrence in the series. In this case, the majority of the lesions were in the long bones including the short long bones of the hands and feet.

Though renal dysfunction and Bence Jones proteinuria have been recorded in 73% and 64% respectively, this case showed no renal dysfunction. Urine test for B. J. protein was consistently negative throughout the 8½ years of the disease. A positive B. J. protein reaction was obtained a few weeks before death. One feature which has not been reported before is the subperiosteal new bone formation seen in the lesion in the tibia. The effect of deep X-Ray was remarkable as will be seen from the X-Ray pictures before and after treatment showing skull, sternum, tibia and patella. At the time of his last but one admission into hospital he came in a very bad state with symptoms of intracranial tumour. The improvement in symptoms was marked after deep X-Ray exposure. As noted by *Chormley and Pollock* the individual lesions showed remarkable regression after deep X-Ray exposure but the irradiation could not prevent the appearance of fresh lesions nor alter the fatal prognosis of the disease.

He went downhill soon afterwards and died.

## SUMMARY

A case of multiple myeloma occurring at the unusually early age of 17 years is described. A follow up of 8½ years was possible in this case and showed certain very interesting features that are detailed. The early onset, the long survival, absence of lesions in vertebra and pelvis so characteristic of multiple myeloma and the absence of pathological fractures are among the unusual features of the case. The peculiar type of lesion in the Tibia showing subperiosteal new bone formation giving an X-ray appearance of osteogenic sarcoma is noted. The remarkable response to deep X-Ray and the fact that the ultimate course of the disease is not affected by the response of the lesion to deep X-Ray are recorded. It is unusual for one in our country to have a chance of follow up in a case for a period of 8 years which I had in this case.

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# TUMOURS OF THE THYMUS

by B. RAMAMURTHI.

Tumours of the thymus are rarely found at postmortem examination and even more rarely noted in the course of clinical examination. Homburger reported the occurrence of 42 instances of enlargement of the thymus in 6,000 autopsies at the Yale Department of Pathology. Of these, five only were true tumours. In 17,000 autopsies at the Bellevue Hospital Symmers found 24 thymic tumours. The Lahey Clinic records six cases of thymic tumours in the course of 300,000 clinical examinations. The following case is reported because of the rarity of thymosarcoma.

Tumours of the thymus can clinically be classified into three groups :—

- (1) Those discovered in cases of myasthenia gravis.
- (2) Those causing typical symptoms of anterior mediastinal tumour with obstruction to the trachea and the great vessels at the root of the neck.
- (3) Those discovered accidentally during X-Ray examination.

Removal of the thymus and tumours of the thymus has been strongly advocated by Blalock as a treatment for myasthenia gravis, though the exact relationship between thymic tumours and myasthenia gravis is not yet fully established.

In suspected cases of anterior mediastinal syndrome and also in cases in which routine radiography of chest reveals abnormal shadows in the mediastinum, the determination of the exact nature of the mass by X-Ray or by screening is not always an easy affair. Plain lateral and oblique views are of great value in such a determination as also is a bronchogram. (See Fig. 2 and 4.)

According to X-Ray findings thymic tumours may present two types of pictures.

(a) One type well defined and easily seen in all radiograms.

(b) The other type, plaque like in shape and easily overlooked. It may be adherent to the aorta or to the pericardium and hence may pulsate and may be mistaken for an enlargement of some part of the cardiovascular system. Fluoroscopy may also be defective in these cases.

Differential diagnosis from other anterior mediastinal tumours like aneurysm, substernal goitre, lymphoma and dermoid cyst is essential. It may be noted here that the presenting signs of dyspnoea, cough and haemorrhage, observed in the case under report, were observed by Decker in about half the cases of malignant thymic tumours. X-Ray evidence was found only in one-third of the cases.

## PATHOLOGY

“No group of tumours has more successfully resisted attempts at interpretation and classification than those of the thymus.”—Ewing. A useful classification will be as follows :—

(a) Hyperplasia of the thymus.

(b) Thymoma (i) benign which is encapsuled and (ii) malignant which is not encapsuled.

The presence of Hassl's corpuscles and epithelial elements is helpful but not essential to mark the thymic origin of a tumour and to distinguish it from one of lymphoid origin. Small cells known as thymocytes were seen in the case under report. (Figs. 5 and 6.)

## TREATMENT

Removal of tumours whenever possible is the best way to prevent the development of malignancy or respiratory obstruction. X-Ray therapy has been attempted but, contrary to impressions given in older literature, there is no rapid or great reduction in the size of the tumour. Surgical technique permits complete extirpation of the



Fig. 1.

Showing in an anteroposterior skiagram of the chest, the tumour above and to the left of the heart shadow.



Fig. 2.

Showing in a left oblique view with barium swallow the anterior position of the tumour above the heart shadow.



Fig. 3.

Bronchogram showing moderate bronchiectasis of left lower lobe.



Fig. 4.

Right oblique view showing the anterior position of the tumour.

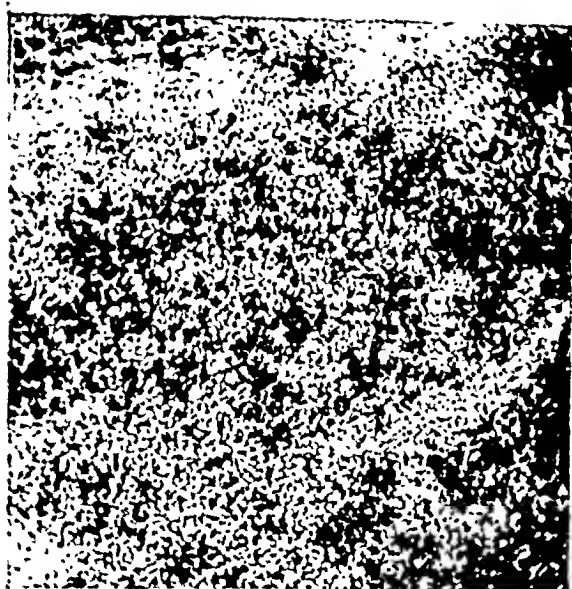


Fig. 5.

Low power photomicrograph of thymosarcoma. Note the round cells—thymocytes and the pale staining reticulum cells with irregular outline.

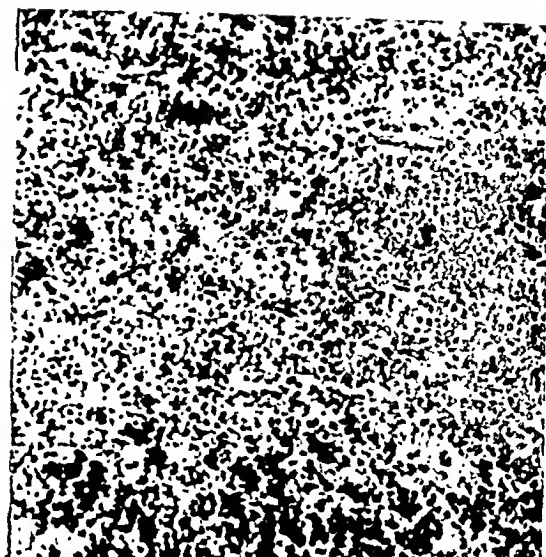


Fig. 6.

High power photomicrograph of the same.

thymus. This can be achieved by an exposure splitting the sternum or by removing one costal cartilage and dividing the others as was done in the case under report.

Discovery of a mediastinal tumour that may originate in the thymus should lead to positive action on the part of the physician. Benign tumours can be removed; malignant tumours if they cannot be removed, can at least be diagnosed by biopsy and irradiated.

### CASE REPORT

K, weaver, aged 30, was admitted into the medical section of the Madras General Hospital complaining of cough with blood stained expectoration since four months and pain in the left side of the chest since eight days. The cough started five years ago with fever in the evenings and since four months has been blood stained. His sleep was disturbed.

Routine examination showed dullness over the manubrium sterni and a few rales over the right base of the lung. Anteroposterior skiagram of the chest revealed a fairly regular rounded shadow projecting beyond the left border of the heart near the medial end of the third and fourth right costal cartilages (Fig. 1).

The patient was screened first without and then with barium swallow and the tumour was seen projecting a little to one side of the heart shadow and not pulsating thus excluding any cardiac swelling. On slow rotation of the patient under the screen it was made out that the tumour was in front of the heart shadow (Fig. 2).

A diagnosis of a tumour in the anterior mediastinum was made, but to make clear the correlation between the tumour and the bloodstained expectoration, a bronchogram (Figs. 3 and 4) was taken to exclude bronchogenic tumour of the lung. It showed only mild bronchiectasis of the right base of the lung. The bronchiectasis explained the cough and the presence of numerous cocci in the sputum. There were no acid fast bacilli in the sputum.

The nature of the anterior mediastinal tumour had to be decided upon. It was too low down for a substernal goitre and did not move with deglutition under the screen. There was no evidence for Hodgkin's disease. It was thought, therefore, that the tumour was either in connection with the thymus or a dermoid cyst. The patient did not reveal any symptoms or signs of myasthenia gravis with which a thymic tumour may sometimes be associated.

The patient was operated upon under intratracheal anaesthesia by Dr. N. S. Narasimhan. As the tumour was rather low down and to the left, the easier method of resection of the third costal

cartilage to expose the tumour was chosen. The pleura got accidentally opened while peeling it off the tumour. The tumour was oval in shape with the long axis in the vertical plane, irregular and lobulated. It was encapsuled and was found below the arch of the aorta and in front of the left auricle not attached to the pericardium. It could be easily removed. After putting in penicillin the wound was closed. The patient received a blood transfusion of 400 c.c. after the operation. The pathological report of the tumour was Thymosarcoma (Figs. 5 and 6).

There was an effusion in the pleural cavity which was aspirated on the 5th day and penicillin put in. The post-operative course was otherwise smooth. The effusion collected again and was aspirated. It was blood stained. The sediment of this effusion showed malignant cells. The complication of pleurisy with malignant effusion, seen in this case has been noted by Crosby.

The patient was, therefore, given post-operative deep X-Ray therapy which stopped the collection

of pleural fluid. He was discharged in good health to report after six months.

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## EXTREME TYPE OF BILATERAL GENU-VALGUM

by T. SESHACHALAM.

Instances of extreme type of bilateral genu-valgum as the one reported here must be rare as the disability and discomfort would bring the patient earlier under treatment. During a period of thirty years of surgical practice in a premier teaching hospital, I have not dealt with one of this extreme type.

wards on the tibia and the feet separated and everted, the ligaments on the medial aspects of the knees and ankles bear the strain. That this deformity is common in childhood and rare in adult life as found in

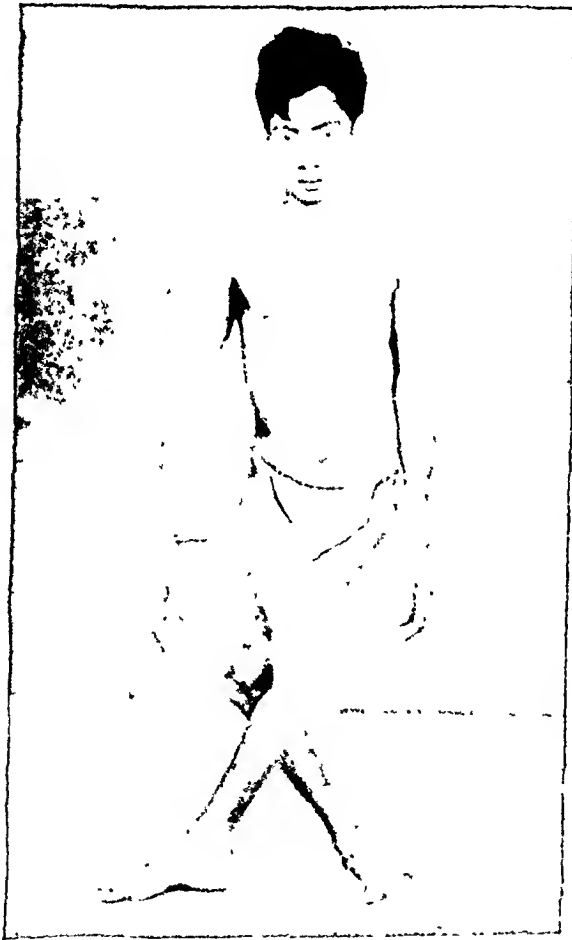


Fig. 1.

Genu-valgum is an exaggeration of the normal attitude of rest in man in which the entire weight of the body is thrown on the ligaments of the three big joints of the lower extremity. The femora being rotated in-



Fig. 2.

hospital statistics is probably erroneous as adults who become accustomed to such deformities of moderate nature do not apply for treatment unless the deformity is so extreme as to disable them.

Mild degrees of knock knee associated with valgus of ankles are corrected by manipulation frequently performed to correct the deformity supplemented by modification of shoes by raising inside of sole and heel by half an inch wedge. If after three months there is no improvement noticed, treatment on expectant lines by forcible correction followed by plaster casts is done. Knock knee in children under 5 years of age do very well under this treatment as the rectifying force of nature lends great help. The necessity for operation implies neglect on the part of the parents or failure of expectant treatment. Supra-condylar osteotomy of the femur to change the inversion and rotation of the femur is the operation of choice.

#### CASE REPORT

Boy aged 18 years, an attender in a hotel has been carrying on his avocation with bilateral genu-valgum, which has been gradually increasing since his childhood resulting in this extreme type (Fig. 1). The gait of the patient has been awkward, his progression slow and the interference of the knees with each other was gradually getting worse. So he sought treatment. The ankles have developed a compensatory varus con-

dition to help progression. Macewen's osteotomy was performed on both sides, deformity was corrected and both limbs were enclosed in a plaster spica extending from the pelvis and enclosing the inverted feet. The original cast was removed in 8 weeks and a second cast excluding the hips was put on allowing the patient to move about on crutches. Perfect mechanical benefit has resulted from the operation (Fig. 2) and when last seen six months after his discharge from hospital the correction has not only been maintained but the formerly dejected boy has now assumed a self confident mood.

#### SUMMARY

A case of extreme type of bilateral genu-valgum with scissor like deformity is reported. The excellent result of Macewen's osteotomy even in this extreme condition is demonstrated.

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#### REVIEWS OF BOOKS

**Buchanan's Manual of Anatomy**, 7th Edition, Edited by F. Wood Jones, Bailliere Tindall and Cox, London, 1946. Pp. 1616, viii.

This is the latest edition of a well tried book. For nearly forty years it has served as a convenient text-book of Anatomy for the senior undergraduate and the post-graduate student, used by him for revising the subject on a topographical or regional basis in the dissection room or Anatomy museum. The paper, typography and binding are better than in previous editions.

The 'magic' touch of the new editor, Prof. Wood Jones, is clearly seen. Much new matter has been added, along with some fine line-drawings from the editor's own artistic pen. The skiagrams are a necessary and welcome addition, and most of them are really excellent. The glossary has always been a feature of Buchanan's Anatomy. It is all the more useful now when modern students of medicine are not required to have a prior acquaintance of Latin and Greek. The short biographical notes on famous Anatomists of the past are stimulative in developing the historical

perspective in the student. This book is highly recommended for the senior student of Anatomy.

A. A. A.

**The Treatment of Malignant Disease by Radium and X-Rays** being a practice of Radiotherapy by Ralston Paterson, M.C., M.D., F.R.C.S.E., D.M.R.E., F.F.R., Shristie Hospital and Holt Radium Institute, Manchester. Published by Edward Arnold & Co., London—1948.

This is the third of a series of publications from Holt Radium Institute, Manchester in recent months. The two previous ones, "Second Statistical Report of the Holt Radium Institute" and "Radium Dosage—The Manchester System" have been received well and read with interest by all English speaking Radiologists. This third one is an important treatise on Radiotherapy, which has been a long felt need.

Radiotherapy though comparatively a very young speciality in Medicine has made remarkable progress in recent times. Ideas about the principles and practice of Radiotherapy have as a result of this rapid evolution been changing from year to year and worker to worker. Several well known pioneer workers in this field have published their experiences in journals and books but the graduate student and the specialist had all along found a lack of definiteness in their statements of technique. Dr. Paterson's work has come none too soon to fill this gap worthily.

This book, as the author claims, is "neither a complete text book nor an attempt to sum up the present state of radiotherapy". It is largely a description of the work done at Holt Radium Institute, Manchester the aim being "a reasonable

synthesis of most that is well tried out" and in this the author has done admirably well steering clear of all controversy and dogma, and placing before the student and the specialist a clear and lucid approach to the practice of Radiotherapy as it stands today.

Beginning with the basic principles of Radiation Therapy, the author deals with exceptional clarity with the details of the technique of X-Rays and Radium Therapy. The Manchester System of Radium dosage is briefly yet thoroughly dealt with and valuable dosage data given and graphs appended. A chapter is devoted to planning and prescription of X-Ray treatment. The chapters on Beam direction and the construction of Radium moulds worthily fill a much needed want and will be read with profit by Radio-Therapists and Physicists alike. There is a chapter on Radiobiology by Edith Paterson, wherein the current views on biological principles of Radio-Therapy have been well summed up. This and the last chapter "New Therapeutic Agents" dealing with Neutron Irradiation and Radio Active Isotopes will be of great value to the student and practitioner. A chapter is also devoted to the organisation of Radiotherapy Departments which the administrator will find very useful.

With all these features the book is bound to be an unqualified success. It is nicely got up with many valuable illustrations. It is indeed a very valuable work which should find a place on the shelf of every Radio-Therapist and practising surgeon, who is interested in the treatment of malignant disease. The greater the number of surgeons that read this book the more will be their contribution to the rational and correct treatment of malignant disease.

K. M. R.

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### The X Annual Conference

The X Annual Conference of the Association of Surgeons of India will be held on the 30th and the 31st of December 1948 and the 1st of January, 1949 at Patna. The Annual General Body Meeting will be held on the last day of the Conference at a time and place to be notified later. All Members are requested to attend. The details about accommodation etc. at Patna can be had from the Local Secretary, Dr. U. P. Sinha, Professor of Surgery, Lawn-North Side, Patna.

Resolutions to be moved at the Annual General Body Meeting should be given due notice of, and such notices should reach the undersigned not later than the 10th of December, 1948.

Nominations for the Presidential election should be sent so as to reach the Hony. Secretary, c/o. Dr. U. P. Sinha, Patna, on or before the 30th of December. 1948.

### Subjects for Discussion

#### 10th Meeting :

##### 1. Intracranial Tumour—

Opener : Dr. A. V. Baliga, Bombay.

Seconder : Dr. R. N. Cooper, Bombay.

##### 2. Talipes Equinovarus—

Opener : Dr. R. Kalamegham,

Trichinopoly.

Seconder : Dr. M. Bahadur Khan,

Hyderabad.

##### 3. Surgical Complications of Typhoid—

Opener : Dr. V. G. Vaishampayan,

Sholapur.

Seconder : Dr. A. V. Baliga, Bombay.

#### 11th Meeting :

##### 1. Treatment of Elephantiasis and Lymph Oedema—

Opener : Dr. V. P. Mehta, Bombay.

Seconder : Dr. T. Kanakaraju,

Ramachandrapuram.

##### 2. Treatment of Hernia with Fascial Grafts and Silk Sutures—

Opener : Dr. P. Chatterjee, Calcutta.

Seconder : Dr. S. K. Datta, Calcutta

##### 3. Treatment of the Bone Cavities in Chronic Osteomyelitis—

Opener : Major D. K. Sabhesan, Madras.

Seconder : Dr. B. N. Sinha, Lucknow.

#### 12th Meeting :

##### 1. (a) Bronchiectasis—

Dr. R. Mahadevan, Madras.

##### (b) Lung Abscess—

Dr. S. J. Mehta, Bombay.

##### 2. Intestinal Obstruction in Children—

Opener : Dr. A. E. DeSa', Bombay.

Seconder : Dr. R. A. Irani, Bombay.

##### 3. Sciatic Syndrome—

Opener : Dr. S. K. Sen, New Delhi.

Seconder : Dr. V. P. Mehta, Bombay.



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# THE INDIAN JOURNAL OF SURGERY

Vol. X

DECEMBER 1948

No. 4

## TUMOURS OF THE SPINAL CORD\*

by R. N. COOPERS

In opening the discussion on spinal cord tumours I can only touch upon a few salient features. An exhaustive review can only prove exhausting to you. When I was a student in London, a legend had grown up that so far as diseases of the nervous system were concerned, diagnosis was difficult, pathology uncertain, prognosis poor and treatment a veritable zero. Much water has flown under the bridge since the pioneer work of Horsley and Gowers in London in 1887. To-day surgery of the spinal cord is placed on a high pedestal. It is sad to comment therefore, that the medical profession of our time has not been sufficiently trained to appreciate the therapeutic possibilities of surgery of the spinal cord. Consequently many a patient is denied the benefits of modern surgery through incomplete and incompetent advice.

### DIAGNOSIS

Early and accurate diagnosis of a tumour of the spinal cord leaves much to be desired even now. However, a correct diagnosis in a very large percentage of cases can be made by being alive to the possibility of a spinal cord tumour in cases of slowly progressive symptoms either sensory or motor traceable to the spinal cord.

Diagnosis can be arrived at, by a rational employment of the following methods:—

- I. Clinical—evaluation of disturbances of the motor and sensory systems and the superficial and deep reflexes.

- II. Mechanical—Queckenstedt's, Ayre's and Davis and Pollock's tests.

- III. Bio-Chemical—Analysis of cerebro-spinal fluid.

- IV. Radiological—with and without the employment of contrast mediums.

### I. Clinical Methods

A detailed history containing a record of the signs and symptoms in their chronological order and a patient investigation of the motor, sensory and reflex disturbances are very essential for a correct diagnosis.

A tumour of the spinal cord is a space occupying lesion and therefore produces its symptoms by compressing the spinal cord and its components. The spinal cord carries motor and sensory impulses and regulates certain reflexes. Naturally therefore the symptoms produced by the tumour are referable to disturbances of movement, sensation and reflex action.

In this connection it is important to observe that the spinal cord consists of superimposed segments and that movements, sensations and reflex actions have a strictly segmental representation in the spinal cord in the lower forms of life. In the human being this segmental representation is maintained to a very great extent and makes the localization of a spinal cord lesion possible.

Early symptoms either motor or sensory are of an irritative nature and the later manifestations have a destructive character. Muscular twitchings precede paresis or paralysis of muscles and root-pains precede loss of sensation.

\*A paper read on 27th December, 1947, at the IX Annual Meeting of the Association of Surgeons of India held in Bombay.

§ K. E. M. Hospital, Bombay.

**Motor Symptoms.**—Motor symptoms usually follow sensory manifestations. If the lesion is proximal to the anterior horn cell the disturbance of the motor system will be of the upper neurone type. If the lesion is in the anterior horn, or distal to it the symptoms will be those of a lower motor neuron type. In testing the motor system

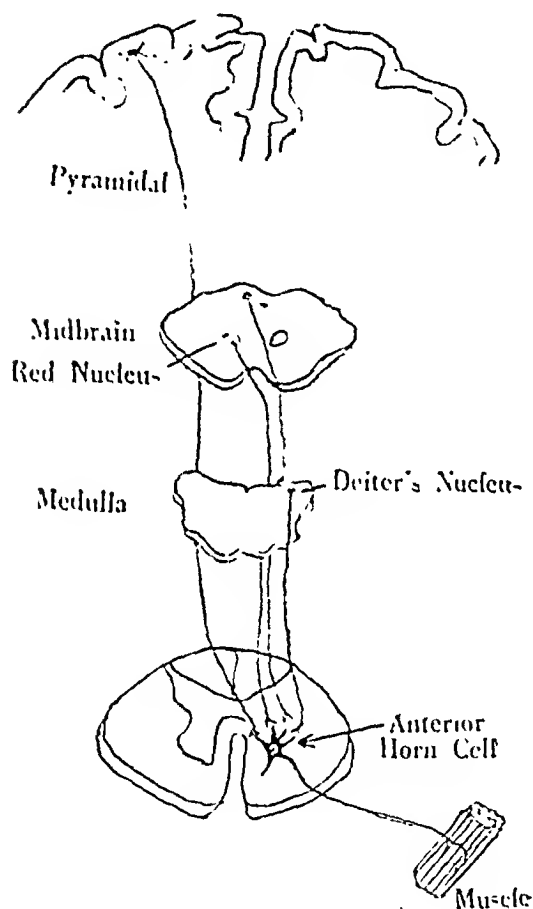


Fig. 1.

it is not enough to see which particular movement is interfered with but it is equally important to test out, the strength of the individual muscles like the trapezius, biceps, triceps, ilio-psoas, etc. against resistance. Early muscular weakness can thus be made out. The diagnostic significance of such a finding will be appreciated by a reference to chart I, which depicts the segmental representation of muscles.

# CHART I SEGMENTAL REPRESENTATION OF MUSCLES

- C. 4. Scaleni, trapezius, levator anguli scapulae, diaphragm.
- C. 5. Levator anguli scapulae, scaleni, supraspinatus, rhomboids, infraspinatus, teres minor, biceps, brachialis anticus, deltoid, supinator longus, serratus magnus, pectoralis major (clavicular part).
- C. 6. Subscapularis, pronators, teres major, latissimus dorsi, serratus magnus, pectoralis major.
- C. 7. Triceps, extensors of wrist and digits.
- C. 8. Flexors of wrist and digits, small hand muscles.

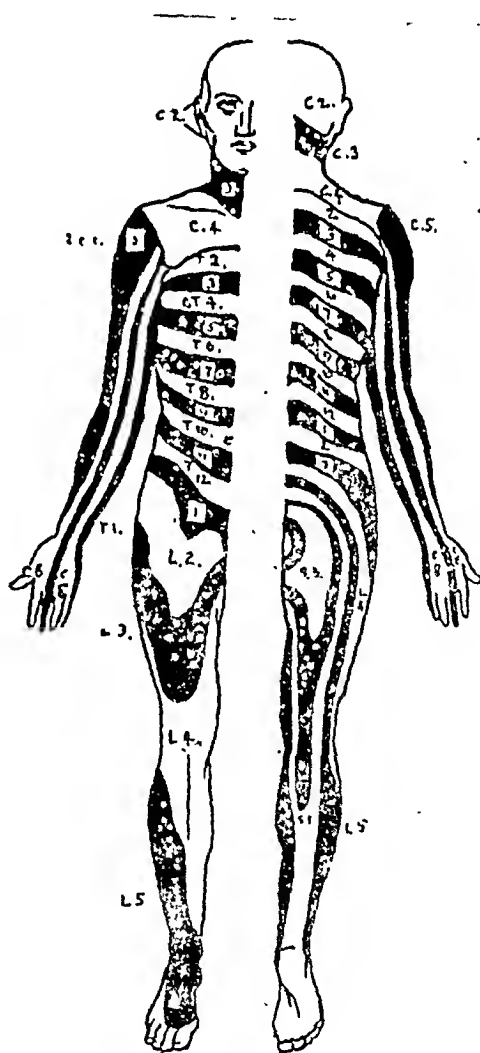


Fig. 2.

Sensory Segmental Localization in the Spinal Cord.

- Th. 1. Interossei and small hand muscles.  
 Th. 2 to 12. Intercostals, abdominal muscles.  
 L. 1. Quadratus lumborum.  
 L. 3. Sartorius, adductors of hip, ilio-psoas.  
 L. 4. Quadriceps extensor femoris, abductors of hip.  
 L. 5. Flexors of knee.  
 S. 1. Calf muscles.  
 S. 2. Glutei, peronei, anterior tibial muscles, small foot muscles.  
 S. 3, 4. Pelvic muscles.

Thus in a case of weakness of a hand it may be found that the flexors of the arm are strong, but the triceps and the extensors of the wrist are weak. It can be inferred from the chart that the lesion is above the seventh cervical segment.

**Sensations.**—Sensations are to be tested for heat, cold, pain, light touch, deep touch, sense of position and vibration. Clinical methods for ascertaining deviations from the normal in these respects are sufficiently well known. The readings obtained should be graphically represented and repeated at intervals to compare them with those obtained on a previous occasion. Any given session should not be unduly prolonged as it is apt to tire out the patient and lead to inaccurate answers.

The loss of sensations resulting from a lesion of the spinal cord or the nerve roots is quite different from that resulting from a lesion of a peripheral nerve. As depicted in Figs. 2 & 3 the loss resulting from a root or spinal cord lesion is of a segmental type. However in the case of a root lesion the segmental loss will affect equally all modes of sensations such as pain, heat, cold, touch, etc.

Once the posterior root enters the cord there is a re-arrangement of the pathways subserving different sensations. As is well known the fibres carrying sensations of pain, heat and cold cross over within the space of a few segments and run along the lateral spino-thalamic tract. The fibres carrying tactile and other sensations pursue for the most part an uncrossed path along the columns of Goll and Burdach. Crossing over takes place above the level of the cord. Thus a tumour situated within the Spinal Cord near its central canal will mainly affect the sensations of heat and cold affecting a certain segmental distribution at the periphery. The sensation of touch, discrimination of position, etc. with the same segmental distribution will not be affected. This peculiar segmental loss is known as dissociation of sensations and is characteris-

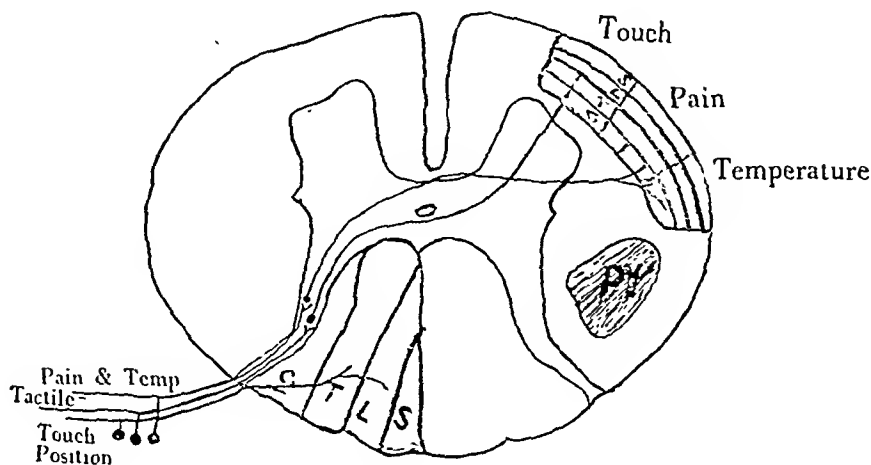


Fig 3

are made worse by coughing or sneezing. This is known as the Naffziger sign. Every act of coughing or sneezing increases intraspinal pressure. A spinal cord tumour acts like a ball-valve when intraspinal pressure is raised, and is in consequence pushed down. As it is pushed down it produces a traction directly or indirectly on the nerve roots. Root pain is sometimes so severe as to require morphine for its relief. Such a pain is often made worse by rest. In fact the pain wakes the patient up from his sleep in about four to six hours after he has retired for the night. It compels him either to walk about on the floor or sleep in a sitting posture.

Root pains are generally intermittent. They may even disappear for a time. Recurrence of pain may occur as the result of a mechanical change of position of the tumour. As the tumour increases in size the root in question may be so completely destroyed as to cause the pain to subside permanently. A careful investigation will show an area of anaesthesia of the segmental type corresponding to the root destroyed. With the appearance of this anaesthesia even the memory of the pain may be absent and the patient may not volunteer a history of root pains. Careful history taking alone may elucidate the existence of such pain.

The root pains in the cervical region may be so severe as to make the patient hold his head and neck rigid. If a lower cervical root is involved, the pain may extend into the shoulder.

In the thoracic region the root pain may simulate intercostal neuralgia, cholecystitis, renal colic or appendicitis. There is an associated zone of hyperesthesia which is slightly above the level of the lesion. As the result of a non-appreciation of root pains mimicking acute abdominal conditions, many unnecessary operations are being performed.

The root pains from the lumbo-sacral cord as also from the cauda equina are referred to the bladder or the rectum or to the lower extremity. The pain along the

lower extremity sails under the ticket of sciatica.

Tingling, numbness or burning are often complained of as subjective symptoms in spinal cord tumours.

In estimating objective sensory disturbances a few points require particular attention. The fibres for pain and temperature after crossing the mid-line ascend in lamellar fashion in the lateral spino-thalamic tract. The fibres from the lowermost peripheral area are pushed outwards by the increasing number of fibres coming from the trunk and the upper extremity. Thus an extra-medullary tumour situated in the cervical region will cause pressure on the outermost layer of the spino-thalamic tract which contains fibres from the sacral region. Hence the sensory loss will be confined to the saddle area in the first instance. As the tumour increases in size the more centrally placed fibres in the lateral spino-thalamic tract will be compressed and the level of anaesthesia will rise. It will however never rise to the level of the tumour. It will always reach up to a level which lies three or four segments below the actual lesion. If due attention is not paid to this anatomical detail the location of the tumour will be missed. For a similar reason, an intramedullary tumour in the cervical region will exert pressure on the most medially placed fibres of the lateral spino-thalamic tract and so the saddle area will remain intact.

The fibres carrying tactile sensations as they run up the posterior columns also get rearranged. Fibres from the lower roots get displaced medially and come to occupy the column of Goll. Fibres from the trunk and the upper extremity run up in the more laterally placed column of Burdach.

Temple Fay reported several cases in 1928 in which the vaso-motor line of demarcation upon the skin corresponded with the upper level of the cord lesion. Similarly a sweating test is employed by wrapping a patient in warm blankets and injecting 1/200 grain of pilocarpine. Sweating does not occur below the level of the tumour.

Frequent use of the determination of the vibratory sense should be made in clinical investigations. Disturbances of vibratory

body than on the other, indicates that the growth is on that side of the cord.

#### CLASSIFICATION OF TUMOURS

Spinal cord tumours are often divided into two groups—extradural and intradural. The extradural tumours are further subdivided into (A) extra-medullary and (B) intra-medullary.

A discussion of the pathology of tumours is purposely avoided.

(A) *Extra-medullary Tumours*: Statistics from various clinics show that extra-medullary tumours preponderate. It is therefore proposed to consider the extra-medullary tumours first and describe some fairly characteristic clinical pictures arising from such tumours at different levels of the cord. It must always be remembered that the history extends over a period of months and even years. Only under exceptional conditions are the symptoms of an acute onset.

#### I. CERVICAL REGION

Above the level of the fourth cervical segment pain in the neck and back of the ear is a prominent early symptom. This causes the patient to hold his neck rigid. The tumour spreading upwards may produce bulbar symptoms.

Later spasm and atrophy of the sternomastoid and trapezius may be noted. Paralysis of the diaphragm may occur.

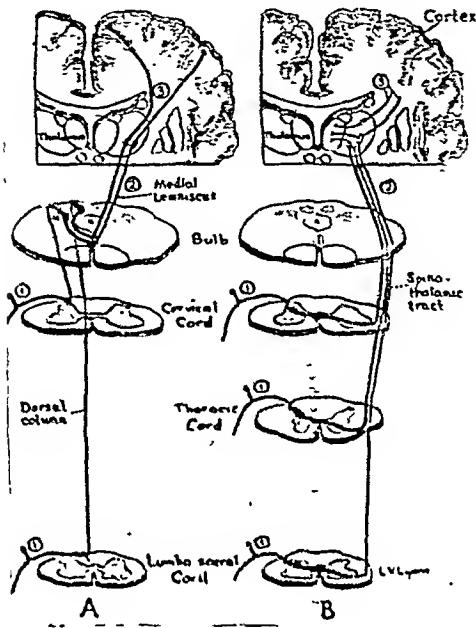


Fig. 5.

Scheme of dorsal column (A) and spinothalamic tract (B) and the paths of which they are a part. (1) first neuron (spinal ganglionic); (2) second neuron (medial lemniscus in A, spinothalamic in B); (3) third neuron (thalamocortical).

and joint sense occur when the entire thickness of the cord is involved. Loss of vibratory sense more on one side of the

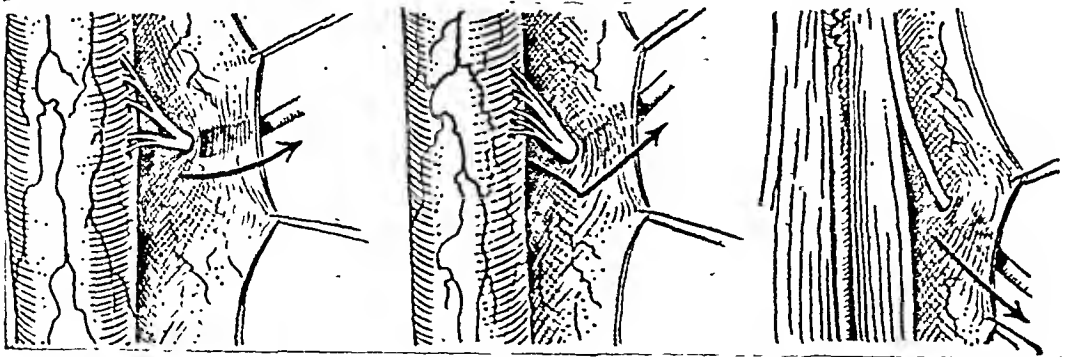


Fig. 6.

Diagrammatic sketch which shows the intradural and extradural course of the posterior spinal roots.

At the level of the fifth and the six segments pain occurs in the shoulders and radiates along the radial side of the forearm, the thumb and the index finger. Weakness and atrophy is most evident in the deltoid, biceps and brachialis.

At the level of the seventh and the eighth segments pain occurs on the inner aspect of the arm and in the ring and middle fingers. Paralysis and atrophy are noticed later in the triceps, flexors of the fingers and small muscles of the hand.

Occulo-pupillary symptoms may be present on the side of the lesion with occasional vaso-motor changes in the face. These changes are also observed when the tumour is in the upper two thoracic segments.

## II. THORACIC REGION

The early root pains leading to an erroneous diagnosis of intercostal neuralgia and acute abdominal lesions have been already described. On the motor side a difference in the innervation of the recti muscles is of localising value. A careful note should be made as to how the umbilicus moves on active contraction of the recti muscles. Should the lower halves of the recti muscles be paralysed it is obvious that the umbilicus will be pulled upwards when the recti are actively contracted. It is equally clear that the lesion is situated in the eleventh thoracic segment. In such a case the abdominal superficial reflexes will be absent in the lower half of the abdomen.

## III. LUMBAR REGION

It is to be remembered that the lumbar nerve roots run a fairly oblique course intradurally. Hence root pains are very common in cases of a tumour in this region. Pain is often of the type complained of in cases of sciatica. Sometimes it is referred to the lower abdomen or even the bladder and the rectum.

The lower abdominal reflexes may remain intact but the knee-jerks are either diminished or abolished. The quadriceps femoris muscle may be atrophied. While theoretically the paralysis of the lower extre-

mity should be of the spastic type, in practice one often sees a paraplegia of the flaccid type. This is due to the involvement of the long lumbar roots already described. For the same reason the paraplegia may be asymmetrical.

The sacral segment of the cord is so short and close to the lumbar segment that very often it is difficult to distinguish between tumours of these two regions.

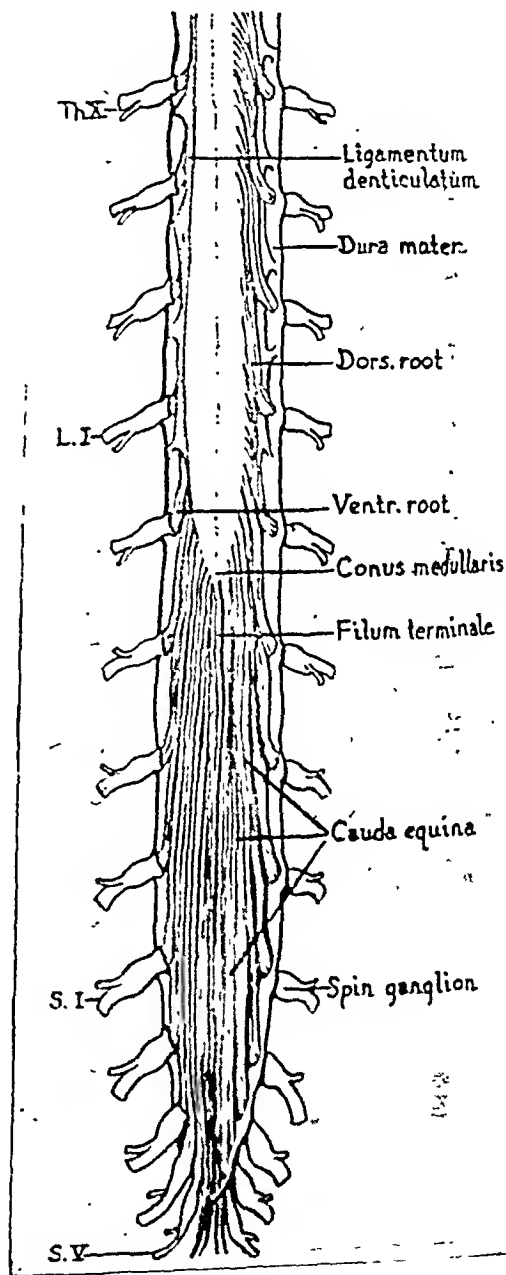


Fig. 7.

## IV. CAUDA EQUINA

Pain is an outstanding feature of a cauda equina lesion. Knee-jerk is almost always absent. The history is spread over a very long period. The paraplegia is asymmetrical and of the flaccid type. The resulting anaesthesia is also asymmetrical but of the segmental type.

## V. CONUS LESIONS

Lesions of the conus are characterized by rapid development of symptoms, absence of pain, appearance of asymmetrical anaesthesia. The last three dermatomes never escape. Fibrillary twitchings and rapid paralysis of the bladder, rectum and intestinal musculature are fairly characteristic features. Knee-jerk may be retained. Again from a practical point of view it is very difficult to distinguish between a conus and a cauda equina tumour before operation.

(B) *Intra-medullary Tumours*: The tumours are fortunately less common than the extramedullary tumours because they are often malignant and from a surgical standpoint they are not amenable to satisfactory treatment.

The symptoms of an intramedullary tumour are in no way pathognomonic. A centrally placed tumour may closely simulate a case of syringomyelia. As syringomyelia is most common in the cervical region it should be considered as the first probability in the differential diagnosis when the lesion is situated in this region. Dissociation of sensations suggestive of syringomyelia, at levels lower than the cervical, should suggest the possibility of an intramedullary tumour.

## II. Mechanical Methods

In 1863 Hilton made an observation on a cadaver. Through a dissection on the lumbar region he exposed the dural covering. When the blood in the veins of the neck was pressed upwards towards the unyielding skull a bulging of the exposed dura mater was observed. In 1916 Queckenstadt applied this observation in the living. The

test which is now named is familiar to all. However, it is essential to emphasise the following points in the elucidation of this test:—

- (1) Position of the head must be level with the spine.
- (2) The neck should be held straight. Bending of the neck compresses the jugular veins.
- (3) The patient should not strain as straining causes a rise in the intra-spinal pressure.
- (4) A nerve root impinging against the lumen of the puncture-needle mimics a block. This obstruction can be removed by giving a turn to the needle or by asking the patient to cough.
- (5) The value of the test is considerably enhanced by making a graphical study incorporating the following points:—
  - (a) Record the initial pressure as soon as cerebro-spinal fluid escapes.
  - (b) Lightly touch the jugulars to note the response. Normally there is an immediate rise and a fall.
  - (c) Compress the neck by employing a manometer cuff to the neck and inflating it to a definite level. In our series all records were made by employing 40 m.m. Hg. as pressure.
  - (d) Note the commencement of the rise till it reaches its peak. In a normal case, the manometer shows a rise from 100-150 m.m. of water to 300-400 m.m. of water within a space of 10 seconds.
  - (e) Maintain compression for 10 seconds.
  - (f) Release compression noting rate of fall. Normally a



## (2) MENINGEAL:—

Tuberculoma, Fibroma Meningeoma, Pachymeningitis with or without Cyst Formation, Endothelioma, Vericosity of Vessels.

## (3) MEDULLARY:—

Fibroma, Ependyoma Gliomas, Angioma, Cysts including Syringomyelia, Abscess, Metastatic Growth.

The indications for exploration having already been outlined it only remains to stress a few important practical details. The anaesthesia of choice varies.

The position of the patient may be prone or semi-prone with due attention to ensure free breathing. A suitable head rest is necessary in operations on the cervical region.

The aim of the operation is to ensure complete excision of the tumour without damage to the cord structures. Occasionally a nerve root may have to be sacrificed to remove its attachment to the dura if recurrence is to be avoided. In intramedullary tumours complete excision is not possible and one has to be satisfied with measures which allow these tumours to extrude themselves. Temporary improvement sometimes lasting for years, may be obtained by such a procedure.

During an operation an attempt should be made to obtain almost complete haemostasis by the use of electro-coagulation, cottonoid strips steeped in hot saline, Horsley's bone wax, muscle grafts and gelfoam pads.

In spite of preoperative localization a definite search has to be made for the tumour during an operation. Should the dura pulsate freely on exposure the tumour is evidently below the segment explored. If on the other hand the exposed dura does not pulsate there are two possibilities. If the exposed part is the tumour itself

tumour lies above the non-pulsating area. In many cases palpation with the finger may help to distinguish actual tumour from a non-pulsating dura. For further help it is necessary to open the dura. A practical way to ascertain the presence of a block, is to pass a thin rubber catheter through the dural aperture in both directions. The progress of the catheter will be stopped by the tumour. Any "Lipiodol" employed should be washed out by squirting sterilized normal saline through a rubber catheter attached to a syringe. The dura is closed up as far as possible completely. It may be anchored to the periosteum or superficial structures to keep it away from the cord and to prevent any collection taking place between the dura and the soft parts.

During the after treatment pressure over shoulders and hips is to be avoided. Sulfanilamides and penicillin may be judiciously employed. Indwelling catheter with frequent irrigations may be necessary. Turning the patient by four assistants with the help of sheets properly arranged under the patient helps proper nursing.

## PROGNOSIS

Surgical mortality in good hands is less than 4%. Unless irreparable damage is done to the cord or its blood supply, a complete recovery is the rule in extramedullary tumours. Recovery of motor, sensory, vesical and rectal functions occurs in the reverse order in which they were affected. In intramedullary tumours recovery is partial as already stated. 25% of loss of function is usually recovered in three months; 50% in six to twelve months; 75% in twelve to eighteen months and total recovery may require as long as two years. No further recovery is to be expected after this date.

An analysis of results will be given by Ginde.

# SPINAL TUMOURS\*

by R. G. GINDE§

Spinal tumours form one of the most fascinating fields of neuro-surgery. They remind us of their being a possible cause in various disorders affecting the trunk and the limbs especially, when the clinical picture shows a progressive alteration in the function of the spinal cord or the peripheral nerves. Their successful removal is a source of great joy to the surgeon and to the unfortunate patients alike, as the latter is helped back to a normal life from the miserable state in which he is often found. Such a happy ending is seen only occasionally in our country as the few cases that are diagnosed are in a stage when surgery offers little hope owing to destructive changes produced in the spinal cord from long-standing pressure of the relentlessly progressing neoplasm. The most important step towards this end is *early diagnosis*, because, on the technical side, surgery of spinal tumours though recent, has made such rapid strides during the last 60 years, that the number of cases treated successfully now runs in thousands.

The material includes the study of neoplasms arising from the spinal cord, the nerve roots, meninges, etc., lesions of the intervertebral discs and such other lesions where a pre-operative diagnosis of an intraspinal tumour was made.

Spinal tumours (in Bombay) appear to be uncommon, but are not rare. The records of the K.E.M. Hospital do not show a single case of a proved spinal tumour from its inception in 1926 till 1939, i.e., nearly 14 years, although attempts were made once in 1926 and again in 1929, (both due to a happy coincidence by Dr. R. N. Cooper). The first case of spinal tumour, suspected clinically and by investigations, was in a

friend of mine who was operated by Dr. Cooper and myself at the end of 1940. Since then, we have been able to study this problem and are able to present before you a review of 25 cases. The yearly incidence of these cases is given in the table below :

TABLE I  
SHOWING INCIDENCE OF CASES (25)

Year	No. of cases	Private	From P.M. Records
1939	1	—	1
1940	3	—	1
1941	2	—	—
1942	1	—	—
1943	2	—	—
1944	2	—	—
1945	5	1	—
1946	6	2	—
1947	3	1	—

Before 1938, there were no cases of spinal tumours. The first case was obtained from the autopsy room in 1939. Out of the 3 cases in 1940, one died before the operation, and the diagnosis was confirmed *post-mortem*. But since then, a more or less regular series of cases have been diagnosed and operated. Considering the average incidence of 2 to 3 cases per year, it is rather surprising that no cases were discovered in the previous years. The age and sex distribution of these cases have been as shown below :

TABLE II  
SHOWING AGE & SEX DISTRIBUTION

Age	Male	Female	Total
1-10	—	1	1
11-20	—	2	2
21-30	6	1	7
31-40	10	2	12
41-50	1	—	1
51-60	2	—	2
	19	6	25

Of these, 19 have been in the male and 6 in the female.

\*A paper read on 27th December, 1947, at the IX Annual Meeting of the Association of Surgeons of India held in Bombay.

§ K. E. M. Hospital, Bombay.

The author is grateful to Drs. R. N. Cooper, Y. M. Bhende, V. R. Khanolkar and Major Leo Kreiner for encouragement, help and guidance ; and to Drs. Kaikini and A. E. de Sa for permission to include their cases.

The youngest subject was in a female child of 3 years and the oldest in a man of 54. The majority of these tumours (19) have occurred between 20 and 40 years. As regards the sexes, they occur with approximately the same frequency, the apparent preponderance in the males seen here is probably due to the proportionately larger male attendance and male beds in the hospital.

As regards occupation, spinal tumours have no special predilection and are found in people in all walks of life. This is the case in this series. A previous history of trauma in the form of a fall, strain, etc., was obtained in most cases of disc lesions but not in those who had neoplasms in the spinal canal.

### Symptoms

Most of our cases have sought medical aid at a rather advanced stage of the disease. However, their early symptoms were as shown in the table.

TABLE III

#### SHOWING EARLY SYMPTOMS (25 CASES)

Symptoms	No. of Cases	Site of Lesion E.D. I.D. I.M.			Duration
1. Root pains	13	8	5	—	3 mths. to 7 yrs.
2. Paraesthesias(10)					
Tingling and numbness	9	2	7	—	} 2 mths. to 8 yrs.
Burning	1	—	1	—	
3. Weakness	6	2	4	—	2 mths. to 4 yrs.
4. Pain in the back	13	10	2	1	3½ mths. to 12 yrs.
5. Paraplegia	1	—	1	—	8 mths.
6. Retention of urine	1	—	—	1	10 mths.
7. Lump in the back	1	—	1	—	? 3 yrs.
8. Temperature	2	—	1	—	2 to 3 weeks

The predominant symptoms have been sensory, in the form of root pains and pain in the back which occurred in 13 of them, and paraesthesias in 10. They were also more common in those who showed an extradural lesion. There were also inter-

vals of remissions in these attacks of pain in some of them. On the motor side 6 patients complained of weakness and one developed paraplegia fairly rapidly. In a patient with an intramedullary tumour in the region of the conus, retention of urine developed quite early. For some unexplained reason, two patients gave histories of irregular fever for 2 to 3 weeks, following which their symptoms became rapidly worse. The signs and symptoms at the time of admission were as shown in table IV.

TABLE IV  
SHOWING SIGNS & SYMPTOMS AT THE TIME OF ADMISSION

Symptoms & signs	No. of cases	Site of Lesion E.D. I.D. I.M.			Duration
1. Paresis	1	—	1	—	2 yrs.
2. Paraplegia					
(15) Spastic	8	2	6	—	3 mths to 1 yr.
Flaccid	7	2	4	1	1 to 8 months.
3. Sciatica	7	7	—	—	A few months to 7 yrs.
4. Hyposthesia	5	3	2	—	} A few months to 1 yr.
5. Anaesthesia	12	3	8	1	
6. Disturbances of sphincters (11)					
Retention	—	1	—	—	} 1 to 10 months.
Hesitancy	—	—	1	—	
Precipitate	—	—	2	—	
Incontinence	—	1	5	1	
7. Bed sores	3	—	2	1	2 to 4 months.
8. Tenderness in spine	10	4	5	1	—

Thus out of the present series, 15 were already bed-ridden, 17 had hyposthesia and anaesthesia and 11 had affection of the sphincters at the time of admission. In spite of this, as has also been the experience of other observers, only 3 of them had bed sores in the anaesthetic areas. 10 patients had tenderness in the spine.

### Investigations

The usual routine investigations such as urine, blood cytology, Kahn and Wassermann reactions, gastric analysis, etc., were done whenever indicated and are mentioned in the brief notes of the individual cases at the end.

SPECIAL INVESTIGATIONS FOR THE DIAGNOSIS  
OF INTRASPINAL LESIONS

*Plain x-ray of the spine:* This is one of the simplest and extremely valuable methods of investigation. Not realising the value of this as a routine procedure in all spinal tumour suspects, it was not carried out in some of our early cases and later, it could not be carried out as a separate investigation in a few others, owing to a great shortage of x-ray films. Plain x-rays were studied in the antero-posterior and lateral positions and at times, even in oblique views (using a standard technique and focussing the rays through the suspected area) in 15 of these cases. It was of positive value and very suggestive of even the site of the lesion in 12 of them. It was helpful in 6 cases of neoplasms of the spinal canal and in 6 cases of disc or ligamentous lesions. In one of the rest, it was not possible to interpret the changes because of an extreme degree of kyphoscoliosis. In the remaining 2, there was no change. One of them had 2 arachnoidal cysts at the lower end of the spinal canal and the other a small meningioma. Localised areas of bone destruction, occasionally calcification, spur formation, paraspinal soft-tissue shadows, narrowing of the intervertebral disc interval, etc. should be noted. The horizontal interpediculate distances (H.I.D.) should be measured in mm. and compared with a standard by the erosion and flattening of the pedicles. In America, Elseberg and Dyke and Camp have studied this problem and the former has produced a chart of the normal measurements of H.I.D. in adults along the whole length of the spinal canal. When the H.I.D. of some of our spinal tumour suspects (later confirmed at operation) which showed the erosion and flattening of the pedicles were compared with this chart, it was noticed that these were below the American figures. So, under a grant from the Indian Research Fund Association, an attempt was made to work out an Indian standard and the results of this investigation have been shown in the chart opposite.

*Lumbar puncture and manometric studies:* No examination of the nervous system becomes complete without the examination of the fundi and the C.S.F. Lumbar punc-

TABLE V  
SHOWING COMPARISON BETWEEN THE AVERAGE HORIZONTAL INTERPEDICULATE DISTANCES OF  
ELSEBERG AND CORRESPONDING INDIAN FIGURES  
(TOTAL NUMBER, 150: MALE 100, AND FEMALE 50)

	CERVICAL						THORACIC						LUMBAR										
	2	3	4	5	6	7	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5
Elseberg's	30	30	32	32	32	31	27	23	22	20	20	20	20	20	22	21	23	26	28	29	30	31	33
Indian: Total	27.4	26.2	27.8	28.7	29.1	27.9	23.8	20.2	18.8	18	17.7	17.6	17.7	17.7	18.2	18.4	19.8	22.4	22.4	23.6	24.5	25.6	29.4
Indian: Male	28.1	27.5	28.4	29.3	29.7	28.4	24.3	20.7	19.2	18.4	18.1	17.9	18	18.1	18.5	18.7	20.1	22.8	23.9	24.1	25	26.2	29.7
Indian: Female	26.7	25.8	26.8	27.8	28	26.9	22.7	19.3	18	17.3	17	17	17	17.1	17.7	17.8	19	21.7	22.3	22.8	23.4	24.3	28.9

N.B.—For Clinical use please read x to x.4 = x and x.5 to x.9 = y (x+1)

ture was attempted in 24 cases. In 3 of these it was unsuccessful, because of osteo-arthritis in one, because of marked spasm with scoliosis in the second, and because of a giant tumour occupying this region of the spinal canal in the third. In 5 cases, only the Queckenstedt's test was done. But later, it was done more systematically as a routine, using the *amyl nitrite test* (of Elseberg and Hare) and the *graduated jugular compression test* on the Grant-Cone principle to determine the presence of or otherwise and the degree of subarachnoid block. The double puncture method—cisternal and lumbar—as suggested by Ayer, or, its modification as suggested by Davis and Pollock were not tried as the information obtained from the above mentioned tests were sufficiently diagnostic. The multiple lumbar puncture method of Elsberg and Cramer for the lesions suspected to occupy the lumbar pond was done in the case of giant tumour occupying the whole of the lower half of the spinal canal. No fluid was obtained from any of the lumbar spaces. Unfortunately the material from the needle was not examined for the nature of the cells (a sort of aspiration biopsy).

**Cerebro-spinal fluid:** This was examined as a routine and the Wassermann reaction was also carried out. Out of the 21 cases where c.s.f. was obtained, the lesion was above the site of the puncture in 19 cases. The proteins were increased in 16 of these without any increase of cells (Nonne syndrome)—a very significant finding. Only one case of prolapsed disc showed pleocytosis of 24 cells per c.mm. The fluid was clear in 9 cases. In 3 of these, the neoplasm was in the cervico-thoracic region and in 6, it was in the lower thoraco-lumbar region. Of the latter, 5 had lesions of the intervertebral discs and ligamentum flavum (i.e. where the subarachnoid block was only partial.) The proteins were increased to 0.9% (and probably more as the exact estimate of the protein was not made but the approximate figures were obtained from comparison against standard capacity

tubes). In 3 cases, which also showed xanthochromia, the proteins had increased so much as to produce spontaneous coagulation.

Seven of these 19 cases, showed *xanthochromia* from pale to golden yellow, (giving an incidence of 42%). In 6 of these, the lesion was located in the lower thoraco-lumbar region (giving an incidence of 82%—a finding which compares very well with that of Elseberg for lesions at this site 76%).

The remaining 3 cases where the protein content was normal, had evidence of arachnoiditis in 2, and vertebral pathology—viz, congenital kyphoscoliosis with compression myelitis—in the third. These findings have been summarised in a table below.

TABLE VI  
SHOWING CEREBRO-SPINAL FLUID  
(16 CASES)

Findings	Total No. of cases	Level of the Lesion	
		Cervico-Upper Thoracic	Lower Thoraco-Lumbar
Increased proteins	16	4	12
Clear fluid ...	9	3	3
Xanthochromia ...	7	1	6
Spontaneous coagulation ...	3	—	3
Normal cells (1-5)	15	4	11
Pleocytosis (24 cells) ...	1	—	1

**Gas myelography (with air or oxygen):** This is one of the most helpful, at the same time relatively harmless, investigations especially for the diagnosis of intraspinal lesions in the lower part of the spinal canal. As a matter of fact, a few clinics in America are using it in preference even to "Pantopaque" myelography for the diagnosis of disc lesions. This was carried out in only 2 of our cases and was diagnostic of the situation and the probable nature of the lesion in both of them. However, again owing to shortage of x-ray films, this procedure

could not be applied more extensively. About 40—55 c.c. of air should be injected after removing even a little greater amount of c.s.f. Then with the patient in 40° Trendelenburg position and lying supine, plain or stereoscopic pictures are taken.

Two other investigations which might have helped to confirm the level of the lesion as well as its probable nature were not carried out. One of them is the *sudomotor test of Fay*. It consists of inducing sweating by giving the patient an injection of gr. 1/200 of pilocarpine followed in a few minutes by hot coffee and gr. 5 of aspirin (by mouth). The upper limit of dry skin corresponds to the level of the affected segment of the cord. It was not carried out in our cases as the diagnosis had become clear from other investigations, but I admit it should have been used as an additional confirmatory and helpful measure. The second investigation was the use of *myeloscapy* introduced by Pool in America. It is said to be no more disturbing to the patient than a lumbar puncture and it allows the usual manometric tests to be carried out, and is helpful in diagnosing many of the intra- and extra-dural lesions of the lumbo-sacral region. At times, it may even save a laminectomy. Not having seen this instrument, I am unable to comment on this from personal experience.

*Opaque myelography*: A number of radio-opaque substances such as "Lipiodol," "Thorotrast," "Abrodil," "Pantopaque," etc. have been used for this procedure. Of these "Pantopaque" (ethyl iodophenylundecylate) appears to be the medium of choice at present. It is least irritating to the subarachnoid tissues, being less viscous, gives a sharper outline of any filling defect and can easily be removed through a lumbar puncture needle. If left inside, it also gets completely absorbed in course of time at the rate of approximately 1 c.c. per year. I have not succeeded in getting this stuff in spite of my trying for the last two years. So we have continued with "Lipiodol" myelography in our cases, at first without other investigations except the examination of the

c.s.f. and later to confirm the diagnosis (presence and site) and at the same time to gain some experience with the appearances produced in different lesions. Lipiodol is known to produce irritation of the subarachnoid tissues and is likely to get even encysted. So, care was taken to employ it a short time before the exploration, and to remove the oil as far as possible by washing the subarachnoid space with saline at the time of the operation. In a case, where no block was seen, it was removed through a small burr hole over the sacrum. If early and partial blocks have to be spotted, it is extremely important to fluoroscope the patient after injecting "Lipiodol" before taking the pictures.

Lipiodol myelography was employed in 22 cases in this series. In the remaining 3 cases where it was not used the diagnosis was missed in one, was made by air myelography alone in the second and from plain x-ray alone, which showed the erosion of pedicles and vertebrae with extension of soft tissue shadow in the posterior mediastinum in the third. Of the 22 cases, it was helpful in suggesting the probable relation of the tumour to the cord and meninges in 6 of them (cases No. 2, 4, 7, 9, 10 and 17). In 2 cases the extent of the tumour was determined by injecting lipiodol through the cistern as well as through the lumbar puncture. Of the 6 cases of suspected prolapse of the disc, it was definitely diagnostic of the lesion in 4 (cases No. 18, 19, 24 and 25). In one (case No. 24), the possibility of a cauda equina lesion was also kept in mind as there was a complete hold up but a massive central prolapse of the disc was found at the operation. In one case it was very suggestive of hypertrophied ligamentum flavum. In 2 cases showing block only adhesive arachnoiditis and vertebral pathology (kyphoscoliosis) were found to be the cause of arrest of the lipiodol.

### Diagnosis

These 25 cases of intra-spinal lesions have been grouped under (A) neoplasms and cysts (B) disc and ligamentous lesions and (C) miscellaneous.

There were 14 lesions in group A. 12 of these were neoplasms consisting of 5 neurinomas, 2 neurofibromas, 1 neurofibrolipoma, 1 meningioma, 1 angioendothelioma, 1 astroglioneuroma, and 1 case where the diagnosis has not been finally determined as yet. (I may add here that the cases of angioendothelioma and astroglioneuroma were reported as meningioma and spongioblastoma multiforme respectively, in my previous paper read before the staff society of Seth G.S.M. College on 8th September, 1945). There were 2 instances of arachnoid cysts. Ten of these 14 lesions have been intradural, 3 extradural, and 1 intramedullary, which fits in with the observations of others. Four of the neoplasms were so large that the term giant tumour could descriptively be applied to them. One of these was extending from the sixth thoracic to the lower end of the dural canal. Actually it measured 35 cms. x 3 cms. and weighed 50 grams. It is interesting to note that 12 of these neoplasms that were operated were easily accessible to the surgeon, being situated posteriorly or postero-laterally in relation to the spinal cord.

In group B, there were 9 instances of disc and ligamentous lesions. All of these have been in the lumbar region only. Six of them have had protrusion of the intervertebral fibro-cartilage and these were situated at 4/5 L in 3, at 5 L/1 S in 2, and at 2, 3 L in one case. One of this series had a massive central prolapse (case No. 24) producing a complete cauda equina lesion. There was no evidence of multiple protrusions and none of them have shown any evidence of recurrence so far. There were three instances where only hypertrophy of the ligamentum flavum was found to be responsible for the symptoms.

In the group C consisting of 2 cases, one had an arachnoiditis, and in the second, the spinal compression was produced by the vertebral deformity.

### Treatment

All these patients have been treated by an operation, although in case No. 9, the

general condition was very low. There were two other cases where the diagnosis of prolapsed disc was made but these had refused operation. Three of the patients were operated twice, as only a decompression was done in two of them at the time of the first operation, and in the third, as the symptoms had become progressively worse following an operation elsewhere.

*Pre-operative preparation:* The general condition of these patients was improved as required for major surgical procedures. Routine blood grouping and matching was done. Patients with bladder involvement, 11 in this series, were treated with urotropine, and one of the sulpha group of drugs, which were also continued in the post-operative period. In a few cases where the anaesthetic skin showed marked scabitic and staphylococcal lesions, half a dozen or more exposures to ultra-violet rays were employed in addition to the usual treatment.

*Operative technique:* This has been so standardised by now, that in our series we have tried to follow the procedures laid down by Elseberg, Adson, Love and others. These operations are being done usually under one of the general anaesthetic agents; also under "Avertin" combined with "Pentothal," (Sachs), local combined with regional block of the posterior nerve roots (Frazier), and even under spinal anaesthesia. Being fortunate in having the co-operation of competent anaesthetists, the choice of anaesthesia was made in consultation with them. In all our cases except one of prolapsed disc where ether on open mask was given, intra-tracheal ether, N<sub>2</sub>O with O<sub>2</sub>, or cyclo-propane was employed, the intubation having been done in some under "Sodium Pentothal." The operation has lasted for 1 to 2½ hours. Glucose saline followed by blood transfusion has been employed as a routine measure during the operation to combat the shock and blood loss. This was given through a cannula in the ankle vein.

The site of exploration was marked in some cases by using a lead arrow mark

while performing lipiodol myelography or by injecting methylene blue in the skin. Haemostasis from the muscles was secured with hot packs, ligatures and electro-coagulation. In the later stages adrenaline locally and muscle grafts have also been used. It has not been possible to use fibrin foam or gelfoam so far. The muscles were separated sub-periosteally as far as possible to minimise haemorrhage. In our earlier cases complete laminectomies over the whole extent of the incision were done, but latterly, the spinous processes along with the inter-spinous ligaments were lifted up and kept attached at one end for subsequent suturing at the time of closure, and in a few others especially in cases of prolapsed discs it was possible to remove the lesion through a localised hemi-laminectomy and even laminotomy. On exposing the dura the extradural fat, the appearance and the pulsations of the dura were noted, and if the pulsations were not seen the wound was extended cranially. It may be added here that although the bulk of the lesion was found below the level of the lipiodol shadow, a tapering portion of the neoplasm was invariably found extending upwards for varying distances. Once the pulsations were seen an attempt was made to look for any extradural lesion, if the clinical signs and investigations pointed to such a possibility as for example a prolapsed disc, an hour glass tumours or etc. Otherwise after securing perfect haemostasis, the dura was anchored with stay sutures of fine linen and opened, noting the escape of c.s.f. and oil globules which were sucked away with a special suction tube applied gently over a pledget of cotton wool. The subarachnoid space was gently and carefully examined for the suspected lesion. This, when found, was slowly coaxed out of its bed avoiding damage to the cord and the nerve roots. In neurinomas and neurofibromas the affected nerve root has to be sacrificed and also occasionally when a moderately large tumour lies in the antero-lateral position. This was not required in our series as the neoplasms were situated posteriorly or in the region of the cauda equina. Occasionally the ligamentum denticulatum has to be cut to enable the cord to be gently rotated for

approaching tumours on its anterior aspect, and in intramedullary tumours the spinal cord may require an incision through a prominent and avascular area near the mid-line to allow spontaneous extrusion of the tumour to occur. If a cyst is found a fine tube of cellophane kept in may, by allowing the cyst to empty, relieve the patient of his symptoms for years. When no lesion was detected the condition of the spinal cord and the blood vessels was noted, dilated and tortuous vessels indicating a lesion higher up. A fine rubber catheter (No. 4 or 5 F) was passed in both the directions. If no obstruction was met with, the subarachnoid space was washed with saline injected through the catheter to get rid of the opaque oil and any blood that might have accumulated, and after securing haemostasis, the wound was closed in layers. The dura was left open in those cases where a mere decompression of the tumour was made. Not having the facilities, cargile membranes, etc. could not be used to cover the gap, and insulate the nervous tissue. If prolapsed disc was suspected and this was not approachable extradurally, the dura was incised and after its shrinkage due to escape of c.s.f., an attempt was made to remove the lesion extradurally. If this failed, the nerve roots of the cauda equina were gently separated noting any bulging under the anterior dura. This was incised and the protruded portion was removed. Later, the disc cavity was scooped out as far as possible. The wound was finally closed in layers using a glove drain whenever haemostasis was not perfect. A dilute solution of penicillin was instilled into the wound in some of our cases. No bone grafting has been done in any of these cases of prolapsed disc.

*Post-operative management :* The patients after operation have been nursed on their back with change of posture on the sides, every 6 to 8 hours. There have been no facilities for using rubber or air mattresses. However care was taken to avoid pressure sores and burns on the anaesthetic areas. Intravenous medications, including plasma and blood, were given as required. They were put on heavy doses of penicillin (50,000 units) and/or one of the sulfa group of drugs for the first three days, followed



by smaller doses for the next 4 days or so. Urotropine was continued by mouth and at times by injection in cases developing retention of urine and those with cystitis. Tidal drainage (Monro) could not be employed, but bladder irrigations with 1 : 8,000 oxycyanide of mercury and 1 : 1,000 phosphoric acid, were carried out. The glove drain was removed in 24 to 48 hours and the sutures in 8 to 10 days. All the patients were given large doses of vitamin B<sub>2</sub> orally as well as by injections. Those who had marked paresis, wasting, etc. were treated with prolonged physiotherapy and were encouraged to use their limbs actively as early as possible.

**Post-operative complications :** These have been summarised in the table below :

TABLE VII  
SHOWING COMPLICATIONS AFTER  
OPERATION (23 CASES)

Complications	No. of Cases	Result		
		Cured	Died	Untraced
1. Shock	2	2	—	—
2. Retention of urine	3	2	1	—
3. Cystitis	5	1	4	—
4. Bed sores	5	1	4	—
5. Paresis	1	—	—	1
6. Paraplegia	2	—	2	—
7. Pneumonia	1	1	—	—
8. Pulmonary tuberculosis	1	—	1	—
9. Peripheral failure	1	—	1	—
10. Oedema of genitals	1	1	—	—

Two patients developed shock soon after the operation, which lasted for nearly 2½ hours. This was combated with blood transfusion, but one of them although showing improvement died of peripheral failure with pain in the chest—pulmonary embolism?—on the 10th day. Three patients got retention of urine from which 2 recovered very soon. One of them later developed cystitis and bed sore and died 6 months later. Five patients developed cystitis and bed sores. Of these, 3 had already had them for some time before the operation. Of these 4 died, and one case of cystitis was relieved and the bed sore in another heal-

ed. In one patient, the paresis became worse after the operation, and though he improved later and was able to walk with supports, his further progress is unknown as he has not been traced. Two patients suddenly became worse after the operation and developed complete transverse myelitis, probably due to the interference with the blood supply of the cord or mechanical damage at the time of the operation. One of these was a case of a large 'giant tumour' and in such cases, it may be worthwhile waiting for quite a long time after decompression before doing the second stage. One patient developed pneumonia from which he recovered. One case whose paresis became worse following the operation also developed oedema of the scrotum and genitals which subsided as power and sensations returned. One case showed reactivation of a latent focus of pulmonary tuberculosis following the operation, and as a result of this he died 8 months later. Since then, a pre-operative screening of the chest is made as a routine procedure while the patient is undergoing radiographic diagnosis of the spinal lesion. The results of the operations and the follow up of these patients are summarised in the accompanying table :

TABLE VIII  
SHOWING RESULT OF 23 OPERATED CASES

Nature of Lesion	No. of Cases	Operation Result			Follow up Result						
		R	O	D	C	R	O	D	N	T.	

A. Neoplasms & Cysts .. (12)											
Extradural	2	2	—	—	2	—	—	—	—	—	—
* Intradural	9	4	3	2	3	—	—	5	1		
Intramedullary	1	—	—	1	—	—	—	1	—		
B. Disc & ligamentous lesions .. (9)											
Protruded disc	6	6	—	—	5	—	—	—	1		
Hypertrophied lig. flavum	3	3	—	—	2	—	—	—	1		
C. Miscellaneous .. (2)											
		1	1	—	—	1	1	—	—		

\* Three of these patients were operated twice.

### Comments

Although spinal tumours appear to be rare in our country, they must be existing in large numbers. I have presented before you my experience based on a study of these 25 cases. In the first 2 of these, the diagnosis was made post mortem. Of the remaining 23, fifteen had come with paraplegia, 11 of whom had also involvement of the sphincters lasting for 2 or more months, i.e., at a rather late stage of the disease. The diagnosis was not very difficult at that stage. Considering that most of our Hospital class patients also suffer from nutritional disorders, anaemia and even latent or active tuberculosis, they stood the operations well. The wounds in all cases healed well in good time. Some of them however died of intercurrent disorders.

The attendance of patients at the K.E.M. Hospital of Bombay is somewhere between 12 to 15 thousands per year with 3 to 4 hundred patients on an average seeking relief for symptoms referable to the spinal cord or the peripheral nerves. With greater vigilance in looking for earlier signs and investigating a large number of these cases by simple procedures like plain x-ray, manometric and c.s.f. studies as shown above, and repeated examination of the progress of these cases, I feel certain that a much larger number of intra-spinal lesions would be diagnosed at an earlier stage, thereby ensuring results more gratifying than those presented before you today.

### CASE REPORTS

#### CASE No. 1: (NEURO-FIBRO-LIPOMA)

K.E.M.H. M/5763 R.A. Female child aged 3 was admitted on 8-7-'39 for a swelling in lower back gradually increasing in size. It was 3" x 3" in size, soft nodular and well defined with no impulse on coughing. X-ray of the spine showed spina bifida of the lower lumbar region. A part of the Lipomatous tissue was excised as the lump was seen attached to the cord through a gap. After the operation, the child got irregular temperature upto 100°-101° F. and expired after 9 days.

At post-mortem, in the region of the 5th lumbar vertebra, there was a gap. The 3rd and 4th lum-

bar spines were absent. There was a fibrous band running from the vertebral column to the cord. The cord showed, above the cauda equina, a tumour of the size of a ping-pong ball, irregularly round, fatty and fibrous. There was a slit like opening communicating the mass with the cord. On cut section and histologically it presented the appearance of Neurofibrolipoma.

#### CASE No. 2: (ARACHNOID CYSTS)

K.E.M.H. No. 10127 N.P.S., a male aged 52, clerk, was admitted on 18-10-'40 for weakness in the lower limbs, difficulty in walking with burning sensation in the soles, thinning of both legs and cramps on stretching for the previous 4 years. Started gradually, at first in the right leg, with weakness and dragging gait, followed by cramps in both the legs and constant burning sensation in the soles. Physical examination showed diminished power in both lower limbs, but more on right side with wasting of muscles. Tone was diminished. There was loss of pain sensation over the saddle area around the anus. Vibration sense was not properly felt in the same area. Plantar response was absent. The knee jerks were brisk with loss of ankle jerks. He had difficulty in micturition especially in starting the act. The prostate was slightly enlarged. He had a dragging gait. Urine showed nothing abnormal. Blood cytology was normal. Gastric analysis showed hypochlorhydria. Blood K.T. & W.R. of C.S.F. were negative. C.S.F. showed xanthochromia, proteins were 500 mgms%. There were 5 mononuclears. Air myelography (stereoscopic) showed a block at 4/5L and 5L/IS showing two cystic bodies. Lipiodol confirmed the findings.

Lumbar Laminectomy was done (by Dr. R. N. Cooper) under intra-tracheal cyclopropane anaesthesia on 9-11-'40. Spines and laminae of 3, 4, 5 lumbar and 1st sacral were removed. The exposed dura looked oily. On opening it 2 cysts of the size of grapes (approx. 2 cms. x 1.5 cms.) between 4/5L and between 5L/IS. were removed. The wound was closed in layers leaving a glove drain.

During the post-operative period he developed cystitis and bed sores and slight infection of the wound. He regained some power in the lower limbs and could walk with support at the time of his discharge on 20-4-'41, at his own request, but he left with persistent cystitis and later, about 7½ months after the operation he expired of ascending kidney infection.

#### Comments :

In this case as there were two definite grape like arachnoidal cysts pressing upon the nerve roots of the cauda equina, the symptomatology was gradually progressing as in a typical case of spinal neoplasm at this level resulting in a lower motor neurone paresis. As the patient had also an enlarged prostate he developed retention of urine after the

operation. This required repeated catheterization leading to cystitis which although the spinal symptoms improved led to his death from ascending kidney infection. Perhaps tidal drainage from the beginning might have helped him.

### CASE No. 3: (ADHESIVE ARACHNOIDITIS)

K.E.M.H. No. N 11545 A.F. A male aged 25 years was admitted on 1-12-'40 for complete loss of power in the lower limbs for 8 years.

3 months after an appendicectomy under a high lumbar puncture for spinal anaesthesia at Goa 8 years previously he started getting numbness in his left lower limbs, which gradually became worse inspite of massage and electrotherapy. Then there was loss of power in his left leg followed by similar weakness in the right lower limb in about 3 months. He then developed low fever for one month. About this time he found gradually increasing difficulty in walking and could walk with support for nearly 6 years. He became bed ridden for one year before seeking admission. He had experienced difficulty in passing urine for the previous 2 years.

On examination he had a spastic paraplegia but more marked on the right side. All sensations were lost below the knees and diminished in the thighs. Abdominal reflexes were absent with bilateral Babinski. Ankle and patellar clonus were present.

The lumbar puncture on the first occasion resulted in only a small amount of C.S.F. Second time there was a dry tap. Lipiodol myelography showed a complete block at 11th thoracic vertebra.

Laminectomy of 9, 10, 11, thoracic vertebrae, was done (by RNC & RGG) on 28-1-'41 under intratracheal ether anaesthesia. A membrane like obstruction was detected in the lower part adherent to the spinal cord. This was removed mostly on the sides and posterior aspect, and the wound was closed in layers.

Postoperatively he developed cystitis and pneumonia of the right base from which he recovered. He was discharged on 1-5-'41. His condition then being loss of urinary control without cystitis and recovery of part of the sensations even below the knee especially on the inner side. There was some recovery of power in his left leg. In Dec. 1947 he reported that his condition has remained just the same, no improvement and no worse.

### Comments :

The adhesive arachnoiditis giving the picture of a progressive spastic paraplegia might have very probably resulted from the damage to cord due to high lumbar puncture done for appendicectomy 8 years previously. He sought relief at a late stage after having been bed ridden due to paralysis and sphincter disturbances for six years. As a result

of this and due to the difficulties in completely removing all adhesions and possibly their reformation, due to the nature of the disease, the relief of symptoms was only partial.

### CASE No. 4: (NEUROFIBROMA)

K.E.M.H. N/11935 N.H. male aged 35, farmer was admitted on 12-12-'40 for Quadriplegia of 4 days' duration. 4 years before that he had an attack of hemiplegia and then he felt some weakness in both his upper and lower limbs. 4 months before admission, he noticed one day after getting up from bed, that he was not able to raise his lower limbs, followed in 2-3 days' time with similar helplessness in his upper limbs also. 4-5 days later, he found difficulty in speaking.

On examination, he had a spastic type of quadriplegia with exaggerated deep reflexes, loss of abdominal reflexes, ankle clonus and positive Babinski. The superficial sensations were markedly diminished in all the 4 limbs. The sense of position and joint sensations were lost in the left lower limb. He had also incontinence of urine and stools for a time.

Kahn's test was negative, X-ray spine showed evidence of osteoarthritis, Queckenstedt's test showed a complete block. C.S.F. Wassermann reaction was anticomplimentary, but there was a typical Froin's syndrome, fluid was clear, 3 cells (Lymphos) Proteins 0.9%. Lipiodol injected through cistern puncture remained in the region of the brain and that injected via L.P. route got arrested at 1st thoracic vertebra.

While undergoing these investigations he developed a bed-sore on the right gluteal region (in 5 month's time). On 31-5-'41 he developed high fever 103-107° F with laboured respirations—pneumonia both sides and died of hyperpyrexia.

At the postmortem examination, the vertebral column was opened to reveal a soft pedunculated, vascular extrathecal tumour arising at the level of the body of the 5th cervical vertebra, extending upwards to the 4th and below to the 7th cervical vertebra. This tumour had produced an indentation of the spinal cord. On cutting through this tumour a whorled appearance was seen. Histologically, the tumour showed characters of a neurofibroma. The brain was normal though there was slight increase in the C.S. fluid. The other findings were basal collapse of the lungs, fatty liver, and ascending pyelonephritis.

### CASE No. 5: (NEURINOMA)

K.E.M.H. 0/812 V.G. a male aged 50, a fisherman, was admitted on 23-11-'41 for weakness in both lower limbs of two weeks' duration. He was getting tingling and numbness for about 6 years. Six months prior to his admission he felt weakness in both his lower limbs which gradually increased to

complete spastic paraplegia with disuse atrophy of the muscles. Touch, pain and temperature sensations were lost below the nipples. Muscle sense, vibration sense and joint sense were diminished below the umbilicus. Abdominal reflexes were absent. There was bilateral Babinski. Visceral sensations were normal, and there was tenderness over 2nd and 3rd thoracic vertebrae.

The C.S.F. showed xanthochromia, proteins more than 500 mgs. per cent and two mononuclears; Lipiodol injected through cistern puncture showed a complete block at T2.

Laminectomy of 7C to 4th Vertebrae was done (by RNC & RGG) on 18-2-'41 under intra-tracheal cyclopropane anaesthesia. An elongated tumour 5 cms. x 1.5 cms. bluish-brown, tapering at both the ends, situated intradurally behind the cord was removed from the region of T. 1, 2. Histological examination showed the structure of a neurinoma.

Postoperatively there was rapid improvement. He regained sensation on the 3rd day, and power in the lower limbs in 3 weeks and could walk with support. On 23-4-'41 he could sit up in bed but was unable to walk unaided. There was anaesthesia only below the ankles. He had completely recovered pain and temperature sensation. He regained control over micturition. However, during this period he developed cough with expectoration. His sputum was positive for tubercle bacilli. He was therefore transferred to a Tuberculosis Hospital where unfortunately he died four months later of pulmonary tuberculosis.

#### Comments :

In this case there was a definite neoplasm of the nature of a neurinoma pressing on the cord from behind. Therefore the early symptoms were sensory in the form of paraesthesias and were present for 6 years in this case before motor symptoms appeared. However, after this period he rapidly developed complete paralysis. The level of anaesthesia was complete up to the level of the umbilicus but above it, it was so slightly impaired that it appeared normal. Such phenomena in high thoracic cord tumours have been observed by Babinski, Jarkowski and also by Elsberg. His progress after removal of the tumour was very gratifying, unfortunately he died of pulmonary tuberculosis which being latent appears to have flared up as a result of the prolonged anaesthesia required for his operation. A preoperative radiogram of the chest might have been helpful in spotting this lesion. (Babinski J. and Jarkowski .... *Rev. Neurol.* 128 Vol. 532, 1910.)

#### CASE No. 6 : (NEURINOMA)

K.E.M.H. 0/2768. V.M. A male aged 33, clerk, was admitted on 18-3-'41, for difficulty in walking and pain in the abdomen. He had sciatica on the left side 4½ years before this present complaint.

5 months previous to these he had girdle pains around the waists just below the umbilicus which lasted for 2/3 months and then they disappeared. About 2 weeks after the onset of these symptoms he felt tingling and numbness (paraesthesias) in the sole of the left foot which also felt a little heavier than the right. On 15-1-'41 he felt heaviness of the left leg but was able to walk without a dragging gait. A week later he himself noticed the loss of touch sensation upto his right knee. He could walk with support a few steps only from 1-2-'41, till his admission.

On examination then, power was lost in both the lower limbs but more on the left side. Tone was diminished on the left and there was also wasting, again more marked in the left leg. Touch was lost upto 2 fingers below the umbilicus on the right side. Pain and thermal sensations were lost to a level a little below that of touch. Muscle and joint sensations were lost on both sides whereas the vibration sense was lost upto iliac crest on the right side and upto the knee on the left. There was bilateral Babinski and loss of abdominal reflexes on both sides. The knee and ankle jerks were lost on both sides. The spine showed a kyphotic deformity at the level of 6, 7, 8T. vertebrae. There was tenderness over 6th and 7th thoracic spines. He had also two bed sores over his sacrum.

C.S.F. showed a typical Froin's syndrome. Xanthochromia, proteins 0.5%. 3 Lymphos (clot on standing). X-ray after Lipiodol showed a block at the level of 9th T.V. K.T. negative.

He was operated on (by V. M. Kaikini) on 1-5-'41 under cyclopropane anaesthesia; a vascular tumour, intradural but extramedullary of 2" x ½" situated posteriorly at 10T was removed. Histologically it proved to be a neurinoma. He died on 9-7-'41 of ascending kidney infection and bed sores without much improvement in his neurological signs.

#### Comments :

This case showed typical signs and symptoms of a tumour at the lower thoracic region. He had sciatica on the left side 5 years ago. Then relief for nearly 5 years, till root pains appeared which manifested only for a couple of weeks. He also had paraesthesia. All these disappeared when paraplegia developed. The signs were more due to pressure on the postero-lateral aspect on the left side of the cord. This case was under the care of one of our colleagues and the persistence of the paralysis in this case appears to be due to the probable injury to the blood supply of the cord at the time of removal of the tumour.

#### CASE No. 7 : (ANGIO-ENDOTHELIOMA)

K.E.M.H. P/7689. Miss G. A. J., aged 12, a student, was admitted on 13-8-'42 for paraplegia of

3 months' duration. Her complaint started with tingling and numbness in the lower limbs, weakness first in the right leg. 3/4 days later in the left leg. It gradually increased to complete paraplegia. She also complained of absence of sweating below the waist.

Examination showed a spastic paraplegia with loss of all superficial and deep sensations below the umbilicus without any zone of hyperaesthesia. She had a distended bladder with automatic evacuation from time to time.

Plain x-rays of the spine showed increased interpediculate distances in the mid-thoracic region. C.S.F. showed 2 cells, 100 mgms % proteins. Queckenstedt's test showed a complete block. Lipiodol myelography showed a block at 6th and 7th T.V. with 'capping' of the tumour.

She was operated on 5-9-'42 (by RNC & RGG) under intratracheal cyclopropane. An extradural tumour 1½" long x ½" oval tense situated posteriorly was easily shelled out at the level of 7, 8, T. V. Histologically it proved to be an angioendothelioma. As the underlying dura was not adherent the same was not excised along with the tumour.

Within 4 days she showed signs of recovery of sensation which became complete within a month. She began to move her right leg after 2 weeks and could walk without support after 2 months. She had complete recovery of motor power in 4 weeks. The plantar reflexes were then still extensors; these remained so for over 3 years. She regained full control over the bladder in 3 weeks. Since then she has led a normal school life and has passed all her school examinations with credit and is today alive and well.

Seen in December 1947. She is quite hale and hearty and is studying. Her plantar responses are still extensor on both the sides. X-rays taken recently show the Lipiodol still sticking at the lower part of the dural sac. X-rays taken in December 1947, show that there is some attempt at new bone formation in the region of the laminectomy and the pedicles which were flattened due to erosion by the tumour again show the oval appearance with normal H.I. distances.

#### Comments :

This is the only case of angioendothelioma in this series. The tumour gave the classical signs and symptoms of an extradural tumour, situated posteriorly. From the history, the paraplegia appears to have developed rather rapidly with equally rapid and complete recovery after removal of the tumour. Her follow up progress is excellent so far, but as the dura under the side of the tumour has not been removed, it would be interesting to follow this case further especially from the point of view of recurrence. Another

point of interest is that her plantar responses are still extensor—5 years after the operation.

#### CASE No. 8: (CONGENITAL KYPHOSCOLIOSIS)

K.E.M.H. Q/3456. K.M. A male aged 22, a shop-assistant was admitted on 1-4-'43 for paraplegia of 3½ months duration. It started with tingling and pain in the lower limbs and girdle pains just below the umbilicus. The weakness appeared first in the left leg, which was soon followed by similar weakness in the right leg also.

On examination, he showed an upper motor neurone type of paraplegia and a band of hyperaesthesia over the front of left thigh and lower abdomen. The lower abdominal reflexes were absent. He had a generalised Von Recklinghausen's disease with kypho-scoliosis in the upper dorsal region.

Plain radiograms of the spine confirmed the marked degree of kyphoscoliosis. The amyl nitrite test showed a partial block. Lipiodol myelography showed a partial block at 4/5 (It was arrested at that level for 8 days and then partially reached the caudal end).

He was therefore operated on 31-7-'43 (by RNC & RGG) under intratracheal ether anaesthesia and the dura in the upper dorsal region was exposed but no pulsations were noticed. On incising it, no C.S.F. escaped either. Therefore laminae upto 7 c. were removed but no tumour was found. C.S.F. now flowed freely. So the dura and the wound was closed in layers.

His convalescence was uneventful, being able to walk with supports within 3 weeks and was able to work within 3 months; within 6 months of discharge he came back again with stiffness of both the legs and difficulty in walking. He recovered quickly under bed rest, but was given a plaster jacket for 6 months, with complete recovery. He came back again a year later with the same symptoms which again have improved, but only partially with the rest in bed. He is now being fitted with a Taylor's brace with axillary crutches to keep his spine extended. He was able to work for some time after that, but he discarded the brace and again came back with paraplegia a month ago. Again with bed rest he is showing some recovery.

#### Comments :

This patient had a fully developed picture of Von Recklinghausen's disease and when he came with symptoms of paraplegia of rapid onset with root pains and hyperaesthesia, naturally a similar lesion involving one of the spinal nerve roots and compressing the cord was suspected as the cause of his symptoms. Investigations mentioned above confirmed the evidence of compression. But on actual exploration no tumour was detected. Yet

the absence of pulsation of the dura and the absence of escape of C.S.F. on opening it, with block to the passage of a small rubber catheter proved the definite presence of compression in that region. The symptoms quickly improved after decompression probably due to the complete rest in bed following the operation. His symptoms completely disappeared in 4 months and he could even do his duties for a period of 6 months, when his symptoms reappeared. These again subsided with rest in bed and it was then thought that the scoliosis might be getting worse owing to the weakness of the spine after laminectomy. He was put in corrective plasters for 6 months to stabilise the deformity. He was apparently well for some time, but has come back again with a relapse a year later. It now appears that his symptoms are due to some interference with the blood supply of the cord in the region of the deformity which is gradually becoming more and more progressive. It has not been possible to fix his spine with a bone-graft.

This is an interesting case of congenital kyphoscoliosis associated with degenerative changes in the vertebral vessels leading to progressive ischaemic condition of the cord. Borchart, Andrae Thomas et al have described compression paraplegia due to such congenital kyphoscoliosis. It is a very rare clinical entity.

#### CASE No. 9: (ASTROGLIOBLASTOMA OF KINO)

K.E.M.H. Q/11530. F.F. a male aged 30, a cook, was admitted on 14-10-'43 for incontinence of urine, loss of power, tingling and numbness in the lower extremities and pain in the lower back of 3 months' duration. He had already developed one large bed sore over his sacrum and one of 2" diameter over each trochanter.

His complaint started with retention of urine in January '43 which lasted for 5 days and it was accompanied by weakness in the lower limbs. 8 months later, he had a similar attack lasting for 15 days. After admission to the hospital for retention, he developed incontinence of urine and weakness in the lower limbs accompanied by tingling and numbness in the feet and legs only. He was getting continuous and severe pain in the back since 2 weeks.

On examination, he was bed ridden with complete loss of power and tone in both lower limbs with muscular wasting. All sensations were impaired up to the level of the umbilicus with a band of hyperaesthesia just above it. The deep sensations were completely lost in both lower limbs. All the superficial and deep reflexes were lost below the umbilicus. He had also incontinence of urine and faeces, with marked cystitis. His 2nd and 3rd lumbar spines were tender.

On lumbar puncture only a small amount of C.S.F. could be collected which showed Froin's

syndrome. Queckenstedt's test showed a complete spinal block. Lipiodol showed a block at the level of 12 T.V. resembling that due to an intramedullary tumour. (Plain x-rays of the spine could not be taken for shortage of films but the lipiodol myelogram showed marked increase in the interpediculate distances in the region of 12 T to 3 L vertebrae suggestive of a giant tumour of the Cauda equina.

He was operated on on 11-12-'43 (by R. G. Ginde) under intratracheal ether anaesthesia. Laminectomy from 11 T to 3 L was done. The dura was tense and bulging with no pulsations. On opening the dura and manipulating its upper part a spindle shaped highly vascular tumour was seen extending from 11 T to 3 L; C.S.F. and oil globules gushed out. The nerve roots of the Cauda equina, appeared to emerge from its substance. The tail of the tumour was disended and cystic. This part was gently lifted and it appeared to be shelling out. However, the cyst burst and higher up it merged with the cord thus confirming the diagnosis of an extensive intramedullary tumour. So, a partial excision was done and the wound closed in layers without suturing the dura. Histologically the tissue proved to be an astrogloma of Kino. The patient expired 3 weeks later of cystitis and bed sores which he had developed before his admission to the hospital.

#### Comments:

This is a case of a giant tumour of the spinal cord and has again arisen in the region of the cauda equina, which is the usual site of such tumours. Usually ependymomas and neurinomas predominate. However, in this instance it has turned out to be astrogloma of Kino.

The patient had sought treatment at a very late stage of the disease, but was operated on to confirm the diagnosis of the nature of the spinal tumour, in the hope that if it could be shelled out, he might still show some improvement. However, with this diagnosis of an inoperable extensive intramedullary tumour and his low general condition due to cystitis and extensive bed sores, it was not surprising that he expired within 3 weeks of the operation, although the operation wound healed well within that time. As postmortem was not allowed, it was not possible to obtain the tumour along with the spinal cord and the nerve roots of the cauda equina.

#### CASE No. 10: (NEURINOMA)

K.E.M.H. R/11706. H.I. A male 26, labourer, was admitted on 12-9-'44 for paraplegia of 8 months' duration. The complaint started with unconsciousness for 4 days during an attack of fever lasting for 2 weeks. Soon afterwards he noticed some dragging pain in the left epigastrium and weakness of the left leg in walking. A month later, he noticed stiffness of his right leg also. This gradu-

ally increased till he was bedridden. Since 6 months prior to his admission, he was also having girdle pains in his upper abdomen.

On examination, he had a spastic paraplegia with slight disuse atrophy of his calf muscles, loss of all sensation upto the hypogastric region, loss of abdominal reflexes with Babinski's sign on both sides and increased deep reflexes in both lower limbs. He had developed precipitate micturition after a lumbar puncture. He also used to get flexor spasms on and off. There was tenderness of the 8th and 9th T spines following cisternal puncture.

Plain x-rays of the spine showed increase in the inter-pedunculate distances in the region of the 5th, 6th and 7th Th. V. Lumbar puncture. C.S.F. showed Froin's syndrome, xanthochromia, proteins 0.5%, 3 lymphocytes. The jugular compression test showed a complete block. Lipiodol myelography showed a complete block at 6 & 7 thoracic vertebrae showing well marked capping of the tumour.

Laminectomy of 4th to 9th thoracic spines was done (by RNC & RGG) on 4-10-'44 under intratracheal ether anaesthesia. The dura was bulging in the region of the 5th, 6th and 7th thoracic vertebrae, and there were no pulsations. On incising it a bluish extramedullary intrathecal tumour  $1\frac{1}{2}'' \times 7''$  well defined with prominent veins over it was exposed. It was picked up at its lower end by fine forceps and slowly separated and picked out. The subarachnoid space was washed out with normal saline and the wound was closed in layers. Histologically it proved to be a neurinoma.

Within 3 days after the operation, he recovered some sensation and after a week he regained some power with diminution of the rigidity. He had however retention of urine for about a month followed by precipitancy. He progressed satisfactorily and by the end of two months, he was able to stand and walk with support. When examined 8 months after the operation, he had recovery of all sensation, but there was still slight weakness of his left lower limb. The deep reflexes were still slightly plus with extensor plantar on both sides. When last seen in July '47, the plantar response had become flexor and he was going on well with his vocation.

#### Comments :

This is a typical example of a spinal tumour with progressive compression signs resulting in complete paraplegia within 8 months. He has shown complete recovery following surgical removal of the tumour. It was interesting to note that although he had recovered power, sensations, sphincter control within a few months the extensor plantar response persisted for over 2 years.

#### CASE No. 11 :

(HYPERTROPHIED LIGAMENTUM FLAVUM)

K.E.M.H. R/15805. R.D. a male aged 54, municipal school teacher, was admitted on 7-12-'44 for sciatica left side for one year and difficulty in walking for 6 months. He had a fall 3 years previously.

On examination he had diminished lumbar lordosis and the spine was tilted to the right. The 2nd, 3rd lumbar spines were tender on percussion but the movements were normal. Clinically the sacroiliac and hip joints were normal. There was no inequality of the legs. Lassegue's sign was positive. There was no wasting of muscles. No anaesthesia. But, there was hypoaesthesia over the glutei and along the left sciatic nerve. The deep reflexes were normal. Plantar response was flexor. P.R. revealed nothing abnormal. Air myelography showed a constriction in the air column posteriorly opposite 1/2L region.

Laminectomy was done (by RNC & RGG) on 18-12-'45 under intratracheal ether anaesthesia. A 3" incision centered over 2nd lumbar spine was made. The ligamentum flavum was considerably thickened in the region of 1st and 2nd lumbar vertebrae. No herniation of the disc was detected. So, the wound was closed in layer.

The wound healed well. The pain was relieved from the 2nd day and the patient went home walking on 30-12-'44, i.e. in 12 days after the operation.

#### Comments :

This is a case where sciatica was produced by hypertrophic ligamentum flavum. No prolapse of the disc was found. He had a rapid and complete recovery. The diagnosis was made from air myelography and was confirmed at operation and also histologically.

#### CASE No. 12 : (NEURINOMA)

K.E.M.H. S/3022. R.F. a male aged 25, carpenter was admitted on 13-3-'45 for incontinence of urine for 6 months and pain and weakness in right lower extremity for 2 years. His complaint started gradually with pain in his right leg which used to radiate to the thigh. A year later he was operated on at Miraj, a keloidal scar 6" long was seen on the outer side of the right thigh—and that had relieved his pain considerably for about 6 months. Then he experienced difficulty in holding the urine and passed urine in drops all the time. He could not walk and was bedridden. There was a small bedsore over his sacrum.

On examination, his higher functions, cranial nerves and upper limbs were normal. Power and tone were much diminished in the lower limbs, more so in the right. There was also some degree of wasting of the muscles. Fibrillary twitchings were seen in the gluteal region. There was a saddle



shaped area of hypoaesthesia in the perianal region extending for 3" on the back of the left thigh and for 5" on the right side. Joint sensations were normal and vibration sense was doubtful. The abdominal reflexes were normal and plantars were extensor. The knee and ankle jerks were lost on both the sides. His skull and spine were normal. Other systems were normal and p.r. did not reveal any abnormality. His general condition was fair. B.P. 104/60.

Blood Kahn was negative, white cell count was 18,000 per c.m.m. with 87% polymorphs and 13% lymphocytes. Urine showed a fair amount of albumin, r.b.c.s., pus cells and granular casts. Plain x-ray of spines showed the following measurements:

10 T	15.5	
11 T	17	with marked increase in mea-
12 T	19	surement of 1 lumbar region,
1 L	25*	and saucerization of post-
2 L	21	aspect of body of the same
3 L	22	vertebra.
4 L	25	
5 L	31	

**Manometric Tests:** showed complete block by both the amyl nitrite and the jugular compression tests. C.S.F. fluid under tension, showed a typical Froin's syndrome with xanthochromia.

**Lipiodol Myelography:** showed a complete block at 12 T vertebra. He was operated on on 12-4-'45 (by RNC & RGG) under intratracheal anaesthesia. Laminectomy from 12th thoracic to 3rd lumbar. The dura appeared to be distended, opaque blue and showed no pulsations. On opening it after anchoring it as usual, a very vascular tumour adherent to the cauda equina bulged into the wound. It was partially removed piecemeal and the wound was closed in layers leaving a glove drain; post-operatively, he was put on sulpho-namides and penicilin.

On the 3rd day after the operation, he complained of loss of sensation and loss of power in both the lower extremities. His penis became swollen and he lost complete control over micturition. The wound healed well. Later, he was able to move his lower limbs and sensations also returned slowly. The oedema of the penis disappeared. At the end of one month, there was loss of all sensations below the right knee and in the lower two-thirds of the left leg. Histological examination of the tumour tissue proved it to be a neurinoma.

Therefore, the patient was operated on again on 12-6-'45, (RNC & RGG) under intratracheal anaesthesia. Incision from 10th thoracic to 4th lumbar was made and the dura exposed along the whole length. It was noticed that in the short space of 2 months, the soft tissues deep to the muscles had almost formed into mature bone: (Histologically Fibrocartilage). On extending the incision in the dura the greyish red tumour less vascular than

on the 1st occasion, was seen in the nerve roots of the Cauda equina situated more on their anterior and right lateral aspect. Most of it was removed piecemeal and in the attempt two nerve roots got torn. The dura was sutured and the wound closed in layers again leaving a glove drain.

4 days later, touch and pressure was felt upto mid-thigh. 10 days later, touch felt upto the ankle on the left side and up to the tibial tubercle on the right side. Pain slightly felt. Deep sensations were not appreciated and the reflexes were still lost. 5 weeks later, he could flex his legs 30°. Physiotherapy was continued till 20/8, i.e. 9 weeks later. Sensations on the left leg were felt upto the ankle, and upto the knee on the right. He could move his left leg. Deep reflexes lost; plantars absent. He could hold urine for about 10 minutes after he felt the desire. Later on, he could walk with some support. But there was no further improvement in his neurological signs. It has not been possible to obtain further information about his condition.

#### CASE No. 13: (PROLAPSED INTERVERTEBRAL DISC)

K.E.M.H. S/6942. A.M. a male aged 35, cook, was admitted on 7-6-'45 for inability to walk for 1 month. His complaint started with dull aching pains in his knees and tingling and numbness in both the lower limbs for 2 months. While cooking one day he got burnt on his foot and fell down. He had also noticed some wasting of his lower limbs. He was not able to walk since then.

On examination, he was a well built, middle aged man. Higher functions, cranial nerves and upper limbs were normal. He had a lower motor neurone type of paralysis in the lower limbs with wasting of calf muscles, and foot drop. Sensations were quite normal. Knee and ankle jerks were lost, plantar response was absent. His sphincters were unaffected. There was a marked lordosis in the lower dorsal and lumbar region. B.P. 136/90. Other systems were normal.

X-ray of the spine showed diminished disc spaces between 2/3 L with osteo-arthritis changes in the spine, most marked opposite the narrower disc region. Kahn test was negative. L.P. showed xanthochromic fluid, proteins increased to more than 0.5 gm.%, 24 cells, lymphocytes (on two occasions). Manometric readings could not be taken as the fluid was very little. Lipiodol myelography showed partial block opposite 2/3 L disc.

He was operated on (by RNC & RGG) 30th June '45, under intratracheal ether anaesthesia. Laminectomy from 12th to 5 L. On exposing the dura, its pulsations could be seen. As nothing was seen extradurally except a narrowing of the dural sac opposite 2/3 L disc, the dura was opened and immediately C.S.F. and oil globules gushed out. No intradural lesion was detected. On separating the nerve roots of the cauda equina, a bulging of the



anterior dura was seen in the midline. The anterior dura was incised and a tiny nodular cauliflower-like mass 1 cm. in diameter was removed from the region opposite 2 $\frac{2}{3}$  L interspace and the cavity was scooped out and the dura and wound was closed in layers using a gloved drain.

His postoperative convalescence was good, the wound healed well. By 12/7 he could sit up in bed and by 18/7 could walk with support. By 30/7 he could walk almost erect without support and the foot drop became appreciably less. He was discharged on 12-9-'45. Histological examination of the tissue showed the structure of fibrocartilage.

#### Comments :

This was a case where prolapse of the disc had produced a rapidly developing lower motor neurone type of paraplegia. The prolapse of the disc affected 2/3 lumbar disc rather an uncommon site and was large and central, hence the peculiar neurological signs. After operative removal of the compressing disc, his improvement and progress were equally rapid.

#### CASE No. 14: (INTRADURAL CYST)

K.E.M.H. S 7029. G.S. Male aged 34, was admitted on 9-6-'45 with a history of inability to walk or sit up, loss of sensation below the level of the nipples, severe constricting type of pain around the chest, and incontinence of urine and stools for 3 years.

The complaint started in September, 1942 with girdle sensations around the chest and tingling and numbness in his legs in early 1943. He was admitted at the Sassoon Hospital, Poona where after investigations he was given 3 injections of N.A.B. He was no better. Then he took some more treatment from private doctors in Poona and was referred to Bombay as a case of spinal tumour. He had weakness and paraplegia but his sphincters were normal. He was admitted in the J. J. Hospital in January 1944. An extramedullary tumour about the 3rd dorsal spine was diagnosed and he was operated on there on 13-3-'44. On enquiry after his admission here, a cystic mass was said to have been removed from that region and since the operation, he lost all sensations below the chest and also developed incontinence of urine and faeces. Since a few months prior to his admission, he had been getting again shooting pains in the chest but of a more severe nature and also occasional flexor spasms in the lower limbs. He had also developed a bed sore over his sacrum and on the back of both heels.

He had a typical advanced spastic paraplegia with a certain amount of disuse atrophy of the muscles, and occasional flexor spasms. He had lost all sensations from about 2" below the nipple line and just below the nipples there was a zone

of hyperaesthesia. The abdominal reflexes were lost, he had bilateral Babinski with marked exaggeration of deep reflexes and ankle clonus and incontinence of urine and faeces. There was a scar of previous laminectomy from 7th cervical to 6th thoracic spines.

Plain X-ray revealed that the laminae of 4th and 5th thoracic vertebrae had been removed and Lipiodol globules were seen sticking in the same region. The C.S.F. was normal. The amyl nitrite test suggested a partial block while the jugular compression test was normal.

He was operated on (by RNC & RGG) on the 10th July 1945, under intratracheal ether anaesthesia. The previous scar was excised and laminae from 7th cervical to 6th thoracic were exposed. A gap was seen in the region of 4th and 5th thoracic laminae through which the dura could be seen. It also showed normal pulsations. However, the dura was exposed over a wide region to explore the region thoroughly. On opening the dura, a few arachnoidal adhesions were seen around the cord opposite the 3rd and 4th dorsal region. On clearing these, the underlying cord appeared whitish, shrunken and flattened like a tape with pin point haemorrhages over an area of about  $\frac{3}{4}$ ". It was seen floating in the C.S.F. which was freely welling out. As nothing could have been done the wound was closed in layers.

Postoperatively, the wound healed well and surprisingly for a time at any rate, there was some definite improvement in his condition. The flexor spasms became much less. He could feel touch and temperature up to the umbilicus and there was evidence of sweating over his legs, whereas before the operation, they were always dry. He could understand that his bladder was full but did not get any control over it. He could pass his stool normally. He was discharged in the same condition on 12-9-'45.

#### CASE No. 15:

##### (HYPERTROPHIED LIGAMENTUM FLAVUM)

K.E.M.H. S/14737. I.T.L., a male aged 40, mechanic was admitted on 27-11-'45 for sciatica right side for 5 months.

In the beginning, the patient began to get pain in both the heels which used to increase on walking. He consulted his family and other doctors and was treated with salicylates by mouth and also by injections of vitamin B complex and cobra venom with temporary relief. He had no relief after stretching his left sciatic nerve under anaesthesia on two occasions.

He had a limping gait with some degree of wasting of right lower limb. His right thigh girth was  $1\frac{3}{4}$ " less than the left, and his right calf showed wasting to the extent of 1". Lassegue's sign was positive. There were tender spots along the right

sciatic nerve. His sensations were very much diminished on the dorsum of the right foot and outer side of right leg. Right knee jerk was diminished and the ankle jerk was lost. Plantars were flexor.

Plain X-ray showed slight osteo-arthritis changes opposite the 4th and 5th lumbar vertebrae. C.S.F. was normal. W.R. negative. Lipiodol myelography showed a slight constriction opposite the 4th and 5th lumbar vertebrae.

Lumbar right hemi-laminectomy between 5L/1s was done (by Dr. A. E. Desa) on 6-11-'45 under intratracheal ether. The ligamentum flavum was found to be much thickened. There was no prolapsed disc, so the wound was closed in layers with drainage. Histological examination of the tissue showed normal fibro-elastic tissue.

Postoperatively, the wound healed well. A month later, the jerks were normal and except for slight numbness on the dorsum of the right foot, he had regained all sensations. He was discharged cured on 15-12-'45.

#### Comments :

In this case, although clinically the signs and symptoms were very typical of prolapse of the disc, only hypertrophied ligamentum flavum was detected at the operation giving him complete cure. He was seen on 4-12-'47. He is quite fit and doing his former work. No abnormal physical signs. Only at times he gets slight numbness in the skin at the base of 2, 3, 4 right toes.

#### CASE No. 16 :

##### (HYPERTROPHIED LIGAMENTUM FLAVUM)

P.R., a male aged 40. Revenue Inspector, Govt. of Zanzibar, East Africa was seen by Dr. R. G. Ginde in July 1945 for attacks of pain in the back and sciatica for a number of years. He had chronic constipation for nearly 20 years. He got lumbago like pain about 1931-'32 which was relieved after application of some external medicines such as belladonna plaster for 3 days. He had the same pain in 1933 and since then 2/3 times in a year till 1938, the pain lasting for as long as a week. Then he started taking Indian gymnastic and yogic exercises. One day in 1938, while taking exercise, he got a sudden jerky pain and since then he has got more or less continuous pain in the back. The first attack of this pain lasted for 4 days with severe pain followed by continuous stiffness of the back and pain on movement but bearable. The pain in the back used to be worse during coitus and for 2/3 days following it. He had had treatment with salicylates, etc. from time to time. In 1942 while returning from a holiday, he got severe pain in the back and was removed to a hospital in Zanzibar. He was given local injections of novocain. He was treated with Anti-

phlogistine, radiant heat, another injection and gradual exercises and was discharged after 23 days. He stayed at home for another week. But dull continuous pain continued. He was X-rayed and was advised an exploration but the patient refused. So movements under anaesthesia were given with no relief. In 1944, he got a severe attack of sciatica on the right side, and was admitted again in the Hospital and after X-rays, prolapsed disc was suspected and was advised an operation.

At this time, he was still finding difficulty in walking even short distances, but could go on a cycle for about a mile, except that he had to start from a kerb and stop on a kerb, i.e. he could not get on and off in the normal way. During the acute attack the pain in the back used to become worse on coughing, sneezing, etc. The patient being afraid of falling down used to hold on to some support. Since December, 1944, he was having continuous backache, and could walk only with this back held stiff and turned to the right side. Massage, blood letting, and electrotherapy were tried again without any relief.

On examination, he had stiffness of the lower part of the back with tenderness over the 4th and 5th lumbar spines. He had a right sided scoliosis. Hip and knee joints were normal, Lassegue's sign was markedly positive on the right side. There was tenderness along the course of the right sciatic nerve. Knee and ankle jerks were normal. There was an area of hypoaesthesia on the outer side of his right foot. L.P. C.S.F. clear, proteins 0.5% with 2 lymphocytes. Lipiodol myelography showed, in the lateral view of lumbar spine, a posterior filling defect opposite 4/5 L, and amputation of nerve root sleeve of 5 L on the left side.

A Lumbar laminectomy was done (by RGG & RNC) on 15-9-'45 under intratracheal cyclopropane anaesthesia. The spines and laminae were cut as usual. The ligamentum flavum was markedly thickened and hypertrophied especially opposite 4/5 L. The dura was pulsating normally on either side, no evidence of disc prolapse was detected. So the dura was opened and the Lipiodol was let out and the sac washed with saline. The wound was closed in layers, a glove drain was left in for 48 hours.

Postoperatively, he had an uneventful convalescence. He could walk within a fortnight and gave up the stick which he was using for support. In September 1947 a communication was received that he is free from pain and is able to do his work and can walk, climb up and down freely.

#### CASE No. 17: (NEURINOMA)

K.E.M.H. T/9554. Mrs. K.S., aged 20, factory hand was admitted on 11-7-'46 for loss of power with inability to walk for 3 months and incontinence of urine and stools for 2 months.

5 months before admission, she started getting shooting pain with tingling from the dorso-lumbar region across the hip to the right leg. Gradually she began to get similar pain in the left lower limb as well. She also began to get irregular temperature. She continued with her work and the fever subsided in about a month's time. But progressive weakness of both the lower extremities set in. She was crawling on her knees for some time and then became bedridden. About this time, she began to get nocturnal enuresis, later even during day time, so that since two months past, she was having incontinence of urine. She had incontinence of faeces for 2 weeks from which she recovered.

She had amenorrhoea for a year before and she had suffered from frequency of stools with blood and mucus for 2 weeks before the attack of fever (i.e. about 5½ months previously).

She was a short, thinly built, rather poorly nourished woman with a long head and a small face. She had a lower motor neurone type of paraplegia with loss of pain and temperature sensations from 2" below the umbilicus both in front as well as posteriorly. Touch was blunted. Joint and vibration sensations were lost but deep pressure was present. The lower abdominal reflexes were lost and plantars could not be elicited on either side (lost). The knee and ankle jerks were also lost. She had incontinence of urine. There was tenderness over the lumbo-sacral region of her back. Other systems were normal.

Plain x-ray showed marked erosion of the lumbar region of the spinal canal with rarefaction and increase in the horizontal interpediculate distances. C.S.F. (L.P.) was xanthochromic, one lymphocyte, proteins increased to more than 0.5% globulin was increased. W.R. negative. Urine showed a trace of albumin with a few epithelial and pus cells. The amyl nitrite test showed a partial block; as she could not co-operate, the jugular compression test could not be carried out.

Lipiodol myelography through cisternal puncture showed the upper limit of the tumour with well marked capping and that injected through a lumbar puncture showed the lower limit. Laminectomy on 24-8-'46 (by RNC & RGG) under intratracheal with ether. Incision from 10th thoracic to 3rd lumbar spines. The spinous process with the interspinous attachments were cut and lifted up as far as the 10th thoracic level leaving it attached at the upper end. The dura was then exposed. Bluish yellow masses were seen in the dura, which was tense, without any pulsations. The dura was incised and as the upper extent of the tumour mass could not be seen, the incision was extended for 1½" upwards. The tumour mass was removed piecemeal as it had surrounded the cord and the nerve roots of the cauda equina. The tumour was dark bluish in

colour and fleshy in appearance. A few nerve roots of the cauda equina got injured during removal of the tumour. The dura was closed after passing a fine rubber catheter in both directions and washing out the subarachnoid space with normal saline. The spinous strip was replaced and the wound was closed in layers leaving a glove drain. Histological examination showed the structure of a neurinoma.

She showed good progress for a week or so. The wound was clean and healthy. As her condition was low, in spite of transfusions before and during the operation, she was given 2 more transfusions at intervals of a few days. By the 30th August she began to complain of pain in the right side of her chest. No physical signs were detected. Temperature was normal. Respiratory rate was about 26. Penicillin was being continued. She felt a little better. But on the night of 3rd September 1946 her condition became worse and she expired within 4 hours of peripheral circulatory failure, also complaining of pain in the chest right side.

#### Comments :

This is another case of a giant tumour of the cauda equina. Like other cases, here also, the total duration of symptoms was very short—only 5 months. But looking at the size of the tumour it appears that the lumbar pond allows the tumour to grow till it assumes a fairly large size, before definite compression symptoms begin to appear. It is very unfortunate that although the tumour was removed as carefully as possible and she showed signs of improvement, she should have died of peripheral cardiac failure. The sudden pain in the chest, with distress, and shock like condition coming on after 9 to 10 days might have been due to pulmonary embolism. As no postmortem was available, it is not possible to comment further.

#### CASE No. 18: (PROLAPSED INTERVERTEBRAL DISC)

K.E.M.H. T/10135. B.D. A male aged 35, a Captain in the Army was admitted on 23-7-'46 for sciatica left side for 7 months.

He had sustained a fall in 1939 while taking exercise and had stiffness of the back since then. He got an attack of shooting pain in right lower limb in 1941. From 1939 to 1946 he had 6 to 8 such attacks. The worst attack was in 1942, when he was in bed for nearly 3 months. From the beginning of 1946, he had been getting pain in the left lower lower limb, radiating along the outside of the leg, right up to the heel. The first attack lasted for two months and the last attack was in July 1946.

He was a well built man, walked with a limp and had tenderness over the lower lumbar spine and loss of left ankle jerk.

With a provisional diagnosis of prolapsed disc a left lumbar hemi-laminectomy was done (by Dr.

A. E. DeSa) under intratracheal ether anaesthesia, on 3-8-'46. Only the left half of 4th and 5th lumbar laminae were nibbled out. On retracing the dura to the right, the protruding disc was seen and was removed. The wound was closed in layers without drainage. The wound healed well and the patient was discharged 14-8-1946 completely cured of his symptoms. He was examined on 17-12-'47 when he had been feeling 80% better since the operation. He only got occasional catching pain but was otherwise keeping fit.

#### Comments :

This case presents all the features of a typical prolapse of the intervertebral disc. There was a history of a fall followed by stiffness of the back followed by attacks of sciatica at intervals—milder at first and worse and worse with passage of time. There were also intervals of apparent relief. The case was so typical that exploration was done through a hemi-laminectomy. The diagnosis was confirmed, the removal of the prolapsed disc being followed by a complete relief of symptoms.

#### CASE No. 19 : (PROLAPSED INTERVERTEBRAL DISC)

K.E.M.H. T/15304. Mrs. S.R. aged 38, housewife, was admitted on 21-11-'46 for low backache and pain along the course of the right sciatic nerve for 2 years.

2 years before, her complaint started with pain in her right toes, which gradually ascended the right foot, leg and thigh. Pain was shooting in character, radiating from the right sacral region to the distribution of the right sciatic nerve. At first, she felt some relief with injections of vit. B. For sometime before admission, she could not bend down and was getting pain while walking.

She had a limping gait with tilting of her spine to the left. There were branding marks over the right gluteal region and right thigh over the sites of pain. She was tender over the right sacroiliac joint posteriorly and along the course of the sciatic nerve as far as the calf. Lassegue's sign was positive. The lateral popliteal nerve was tender. Her right knee jerk was diminished, while the right ankle jerk was lost. There was no sensory loss and there was a normal plantar response.

Plain X-ray revealed, diminution of the space between 5th lumbar and 1st sacral vertebrae. There was also tilting of the spine to the left. Lipiodol myelography showed persistent amputation of the root sleeve of the 5th nerve root on the right side. Kahn and W.R. were negative.

Right lower lumbar hemi-laminectomy was done (by Dr. R. G. G.) on 7th January 1947 under Ether on open mask anaesthesia. After nibbling 4th and 5th laminae on the right side, the dura and the 5th lumbar root on the right side was exposed. The dura was pulsating normally. The 5th lumbar

root was bulging backwards. On retracting it medially, a cartilaginous nodule was seen protruding from the disc between L5 and S1. This was excised and sent for examination. The disc cavity was then scooped out as far as possible. The dura was next opened to let out the lipiodol. The right 5th lumbar root was seen congested and edematous. After washing the sac with normal saline, the wound was closed in layers without drainage. Histological examination of the nodule showed the structure of fibro-cartilage.

The wound healed by primary intention. The patient complained of pain in the back of her legs for 2 days and had to be catheterised for retention of urine for 5 days. On the 4th day, the shooting pain disappeared. On the 19th day, Lassegue's sign was negative. Knee and ankle jerks were normal. There was no scoliosis in lying position and the gait had improved. When seen 3 months later, there was no pain either in the back or in the right sciatic distribution. She was walking almost erect. 11 months later, 18-12-'47 she had no pain and was quite well.

#### Comments :

This is also a typical case of prolapse of the disc where a localised nodule pressing on the 5th nerve root was responsible for her signs and symptoms and had also produced the persistent filling defect, viz. amputation of the nerve sleeve of the 5th lumbar nerve on the right side. As such, she was explored through a small hemi-laminectomy and the prolapsed nodule excised, thus relieving her symptoms, for now nearly a year.

#### CASE No. 20 :

K.E.M.H. T/15745. Mrs. S.S. aged 25, housewife, was admitted on 12-12-'46, for pain in the lower back, instability of gait, tingling and numbness in the legs, difficulty in micturition and weakness for 8 months.

She gave a history of a fall 10 years previously. She had hurt her back and could not walk for sometime but was cured by medicines. Since 8 months, she had been getting low back-ache, tingling and numbness in the legs and sometimes burning pain in the soles. She had to strain and wait for sometime before she could pass urine. Recently she had lost some weight and was feeling weak. She had scanty menses 4 months before and amenorrhoea since then.

Blood K.T. was + + +. Plain x-ray spine showed a marked widening of the neural canal with increase in the horizontal interpediculate distances, saucerization of the posterior aspect of the bodies of the vertebrae, and rarefaction and erosion of the laminae from the 7th thoracic to 5th lumbar region. The following were the actual interpediculate measurements.

7 T	15 mm.	12 T — 32 mm.	4 L — 43 mm.
8	15.5 "	1 L — 34 "	5 L — 39.5 "
9	16.5 "	2 L — 35 "	
10	18.0 "	3 L — 30 "	
11	22.0 "		

Lumbar puncture in 3 different spaces showed a dry tap, also suggesting a large tumour in that region. Lipiodol myelography showed a complete block at the 7th thoracic vertebra.

On 28-12-46, only a decompressive laminectomy was done (by RGG) under intratracheal cyclopropane, ether anaesthesia. A mid-line incision from 10th thoracic to 5th lumbar was made. The 2nd lumbar laminae were eroded and the tumour was seen actually protruding through it under the sacro-spinal muscles. This appeared to have been due to the tumour protruding through the lumbar puncture openings in the dura. In the lumbar region the laminae were so thin due to erosion that they could be cut with scissors. The dura appeared tense, bluish grey and was not pulsating. The protruded portion of the tumour was taken for biopsy. As the attempt to pass a fine rubber catheter (No. 4 F) under the 9th laminae failed, the incision was extended cranially for 4". The dura was then incised along the whole length and an attempt was made to remove the tumour. This had to be abandoned as the tumour was very firmly adherent to the cord and nerve roots and the wound was closed in layers without a drain. The dura was not sutured.

Within a week, she recovered sensations to a large extent and could move her lower limbs. There was a sense of relief from stiffness and according to her, the lower limbs felt "lighter". The pain in the back was also much less. The wound was quite healthy and healed by primary intention. However, owing to decubitus, and hypoaesthesia, she developed two small bed sores, one on the right great trochanter and the other over the right side of her buttock. The biopsy report came as neurinoma. In view of this and the remarkable progress showed by her, on 18-1-47, i.e. 3 weeks after the first operation, she was explored again (by RNC & RGG) with a view to remove the tumour. The previous scar was excised. As the upper tapering end of the tumour was under the 5th and 6th thoracic laminae, the wound was extended upwards and the laminae were removed. The tumour did not appear so vascular now, and most of it was removed partly in large bulk, partly piece meal by gently pushing it out over a pledget of cotton wool. The tumour was 13½" long (35 cms.) and weighed 50 grams. The wound was washed with saline and closed in layers, leaving a glove drain.

Unfortunately this time, there was no further improvement at all. As was expected, the originally recovered sensations of pain and touch were

present. But she used to get distension of the abdomen and had also to be catheterised. In course of time she became worse, developed two large bed sores over the sacrum and one over each trochanter and went out of the Hospital in disgust. On enquiry, it was learnt, that she died 6 months ago very probably from sepsis from bedsores and cystitis.

#### Comments :

This is the largest true neoplasm within the spinal canal in the present series. The diagnosis was of course very simple. In spite of the large size of the tumour, again her actual duration of symptoms was only 8 months (according to the patient). Her progress after mere decompression was very encouraging. But after the removal of this tumour 3 weeks later, she actually became worse. Very probably she had a thrombosis of some of the spinal vessels or ischaemic gliosis of the cord as a result of interference with its blood supply leading to transverse myelitis, although the removal was done gently by pressure with a pledget of cotton wool. It may also be worthwhile waiting for a longer time after decompression in large neoplasms before the removal is attempted.

#### CASE No. 21: (MENINGIOMA)

Mrs. K.L.S., female aged 32, housewife, was admitted on 4-8-46 for numbness and tingling first in the sole of her right foot which started 5-6 months previously; then in the left. This was followed by weakness and a sense of heaviness again at first in the right leg, then in the left leg, ultimately she could not walk, although she could move her limbs in bed. She was treated for some time by her physician as subacute combined degeneration of the cord. There were no root pains. She had marked hypoaesthesia to all sensations as far as the level of the anterior superior spine of the ilium both in front and at the back. Following a lumbar puncture for investigation, she was getting spontaneous flexor spasms in both the legs and used to take nearly half an hour to pass urine.

Plain x-ray of her spine was normal. C.S.F. showed increased protein with no cells, manometric readings were not done. Lipiodol myelography showed a complete block at the upper border of the 10th thoracic vertebra with a typical concave margin in the lateral picture.

Lower dorsal laminectomy on 6-8-46 (by RNC) from 7 to 12 T spines under intratracheal ether anaesthesia. The level of the 10th spine was marked on the skin with methylene blue. Ligamentum flavum was found to be much thickened and at the level of tumour seemed to be ossified. The cord was tense and showed no pulsations. On opening the dura, a peculiar blood stained adherent arachnoid was seen and was excised. A fine

rubber catheter could be passed caudally but not towards the head. On extending the incision an oval greyish vascular and friable tumour 2 cms. x  $\frac{1}{2}$  cms. situated on the dorsum and right side of the cord was removed piecemeal. A portion of it showed a tough spicule. There was free bleeding from one spot of the cord, controlled by muscle graft and adrenaline pack. The wound was then closed in layers leaving a glove drain in the lower angle.

She made a good recovery and was discharged on 14-8-'46. She is doing very well now. Histological examination (by Dr. Dubash) showed the structure of meningioma.

#### CASE No. 22: (NEURO-FIBROMA)

M.B., male aged 40, from Jamnagar was admitted on 12-8-'46 with a history of vague neuritic pains in his left leg for 5 months. He was asked by his family doctor to give up smoking with no benefit. Vit. B. injections gave no relief. 8 weeks previously, he had complained of pain in his chest and was screened and also radiographed. A well defined shadow in the posterior mediastinum at the level of 5th and 6th ribs on the left side was seen. This was looked upon as probably a localised pleuritic fluid or a growth. When neuritis did not clear up and the left leg began to show signs of weakness, a second x-ray was taken, which showed the original shadow (growth) encroaching and eroding the 5th and 6th thoracic vertebrae. About this time—middle of July '46—he was seen by the surgeon (R.N.C.) at Jamnagar. Soon after that he developed weakness in right lower limb and paraplegia.

On examination, he had a spastic paraplegia.

Manometric readings done on 16th August '46 showed a complete block. C.S.F. showed a Froin's syndrome, proteins being markedly increased.

Middorsal laminectomy on the 17th August '46 (by RNC) under intratracheal anaesthesia. After retracting the muscles on the left side a softish fleshy growth was seen. The 4th, 5th and 6th thoracic spines were removed and their laminae were bitten off. The posterior aspect of the cord was covered with part of the growth and was pulsating. Most of the growth was found to be in the posterior mediastinum. It was removed piecemeal and the part in contact with the cord was also removed. The whole of it was extra-dural. The cord pulsed freely. Annoying oozing from the cavity was controlled with hot and adrenaline packs and then with a pedicled muscle graft. The wound was closed in layers leaving a glove drain. Histologically the tumour proved to be a neuro-fibroma.

Postoperatively, he complained of pain in the feet for 2 weeks. As pain subsided power returned. Patient could just stand and walk with support at the time of discharge. A small bed sore developed over the trochanteric region 2 days after

operation but healed well. The patient is now alive and well.

#### CASE No. 23:

##### (HYPERTROPHIED LIGAMENTUM FLAVUM)

M.A., male aged 50, had attacks of pain in the back with radiation to the posterior aspect of the right leg following some trauma a year ago. Examination showed that motor power was good, sensations were normal but right ankle jerk was diminished. The patient had marked difficulty in turning in bed. The pain used to be aggravated by coughing, sneezing, etc. Two epidural saline injections had no effect on his pain. Lumbar puncture 4/5 L space: the C.S.F. came out very slowly; proteins were increased (102 mgms %). Lipiodol myelography showed some definite indentation opposite the 5th lumbar vertebra. A provisional diagnosis of prolapsed disc was made.

He was operated on on 26th Jan. '47 (by RNC) under intratracheal ether. A midline lumbar laminectomy. The spinous processes were cut and kept aside attached to the upper end for subsequent suture. The 5th lumbar laminae were opened up with a Hudson's perforator, and subsequently partly those of 4th and only in the midline those of 2nd and 3rd lumbar vertebrae were nibbled away. The ligamentum flavum was markedly thickened in the region of the 5th lumbar laminae and the epidural fat was also a little more than normal. The dura was tense and non-pulsating. So, the dura was opened letting out a gush of C.S.F. with oily globules. Cauda equina roots were normal. A catheter passed in both directions easily. The sac was well washed with saline of all Lipiodol and closed with catgut. On retracting it, both ways, no evidence of displaced cartilage was seen. 4th and 5th lumbar nerve roots were normal. The wound was closed in layers leaving a cigarette drain.

His convalescence was good. He has remained free from pain and is able to move about freely.

#### CASE No. 24: (PROLAPSED INTERVERTEBRAL DISC)

K.E.M.H. U/13252. K.M. A male aged 30, cook, was admitted on 22-9-'47 for low backache and weakness in both lower limbs for one year and inability to walk for 3 months and disturbance of micturition for 1 month.

His complaints started very gradually with low backache and sensation of heaviness in both the lower limbs. He noticed difficulty in walking and became bedridden for 3 months. Since then he had been getting burning sensation in the gluteal region and disturbances of micturition—viz., difficulty followed by precipitate micturition. Soon after admission, he got incontinence of urine. The pain in the back used to get definitely worse on coughing, sneezing, etc. He gave history of gonorrhoea and chancroid a year ago.



On examination, he was moderately built and fairly well nourished, bedridden with stiffness of the back and slight tilting of the spine to the left. There was tenderness over the 4th and 5th lumbar spines. He had a lower motor neurone type of paraplegia with marked wasting of the calf muscles and bilateral foot drop. There were no fibrillary twitchings. All sensations were lost over the saddle area in the perineum extending up to the knee on the left and over the posterior aspect of the calf on the right side. There was also loss of muscle and joint sense below the knees. The abdominal and cremasteric reflexes were normal but plantars were absent. The knee jerks were present but ankle jerks were lost.

His urine was normal. Blood K.T. was negative. Plain x-ray of the lumbar spine showed marked osteoarthritic changes in the Lumbar spine with narrowing of the 4/5 L disc. B.S.R. was 10 mm. per hour. Lumbar puncture between 4/5 L and 5 L 1S could not be done probably due to osteoarthritis with calcification in ligamenta flava (as proved histologically). So manometric readings also could not be done. Lipiodol myelography (injected through a cistern puncture) showed a complete persistent block at 4/5 L spine.

Lumbar laminectomy was done (by RGG) on 4-11-'47 under intratracheal ether anaesthesia (after induction with sodium Pentothal). The spines and interspinous ligaments were excised and kept attached at the upper end. These ligaments as also the ligamenta flava were very calcified due to osteoarthritis. The dura was exposed. There were pulsations only in the upper parts. Opposite the disc between 4/5 Lumbar, there was a marked constriction of the dura and this and the distal part did not show any pulsations. An attempt was made to retract the dura to one side and to look for prolapsed disc but could not be done as it was very adherent. So, after anchoring it the dura was opened. The nerve roots of the cauda equina were markedly compressed opposite the disc between 4/5 L vertebrae as if tied with a string and below that they were pale yellow and markedly edematous, each nerve root being more than 2 mm. in diameter. There was no intradural lesion. On separating the nerve roots—a large bulge, about 1½ cms. size, was seen under the anterior dura. On incising this, the prolapsed portion of disc bulged into the wound, which was removed with a forceps. Later, quite a lot of degenerated material was removed from the disc cavity with a scoop. After securing haemostasis, the posterior dura only was partially closed in the upper part, as the oedematous lower portion of the nerve roots could not be safely pushed inside the sac. The wound was then closed in layers leaving a glove drain. Histological examination of the prolapsed disc material showed the structure of fibrocartilage with areas of calcification and chondrification.

Postoperatively, the patient regained some sensations within 48 hours. For the next 2 days he was

actually hyperaesthetic, was able to recognise all sensations over the lower half of the thighs. The wound had gaped a little but healed well. He got some control over micturition within a week. He was able to walk with support in 3 weeks. He is still in the wards and is having physiotherapy and progressing well.

#### CASE No. 25: (PROLAPSED INTERVERTEBRAL DISC)

K.E.M.H. U/16629. B.J.P., a male farmer aged 39, was admitted on 27-11-'47 for low backache and left sciatica as far down as the heel and foot, for the last one year. His complaint started with a vague history of pain starting after lifting some weight in the field. Then it became continuous and shooting in character and used to get worse on straining, coughing, etc. and on sleeping on the left side. This attack lasted for nearly 5 months. Then he went for a change and with rest in bed there was relief for nearly 3 months. On resuming his work the pain recurred and was similar but more severe than before. He branded the whole region of distribution of pain and tried massage, etc. without any relief. He gave history of small-pox 30 years ago, cholera 20 years ago and dysentery 10 years ago. No. V.D.

On examination, he was a well built and well developed man and was walking cautiously with a limping gait on the left side. There were branding marks over the lower back and in left sciatic region. He had scoliosis to the right. His lumbar spine was rather stiff. There were areas of tenderness along the left sciatic nerve. Lassegue's sign was positive. Straight leg raising was very painful at 45° on the left side. Power and tone were diminished in the left lower limb especially below the knee with some wasting of the calf muscles. Hypoaesthesia to all superficial sensations over the posterior aspect of the left leg and thigh up to its upper third. Knee and ankle jerks were brisk on the right side. On the left side, the knee jerk was normal but the ankle jerk was very sluggish. No planter response on the left side. Chest showed evidence of chronic bronchitis with emphysema.

His urine was normal. Kahn test negative. Plain x-ray showed arthritic changes and slight diminution of the space between 4/5 lumbar vertebrae; there was also scoliosis to the right. Lumbar puncture in the two spaces failed, hence manometry, etc. could not be done. Lipiodol myelography showed a persistent partial block opposite the 4/5 L especially on the left side.

He was operated on on 9-12-'47 (by RGG) under intratracheal gas and O<sub>2</sub> anaesthesia after inducing with sodium Pentothal. A lumbar mid-line incision from 3 L to 1 sacral spine; muscles separated subperiosteally; the field was almost bloodless. A few bleeders coagulated with diathermy. The spines and laminae of 3 L to 1 S were well exposed. The ligamenta flava were carefully nibbled away between 4/5 lumbar laminae and spines. The ligament was markedly

thickened and calcified especially on the left side. A portion of the laminae and spinous process of 4th and 5th lumbar vertebrae were also bitten off to expose the dura and the nerve sheaths on either side. At this stage, the dura was accidentally damaged allowing free escape of C.S.F. which was stopped by pressure with a cotton pledget and suction. The right 4th lumbar nerve root sleeve was normal and freely mobile whereas on the left, it was thinned out and had stretched over the protruding portion of the annulus fibrosus (disc). It was also compressed in the intervertebral foramen and so its posterior margin was nibbled away. The cord and nerve root were gently retracted to the right side when the protruding portion of the disc fully came into view. On incising it, soft cheesy material bulged out which was then scooped away. The root was then founded to lie freely in its original position. A little sulphanilamide powder was sprinkled and the wound was closed in layers without drainage.

Postoperatively his pain was relieved in three days and he made a good recovery with complete relief of symptoms. Histological examination showed the structure of fibro-cartilage and areas of calcification and ossification in the ligamentum flavum.

### DISCUSSION

Dr. N. S. Narasimhan : congratulated Drs. Cooper and Ginde for the excellent paper and the presentation. He wished to know how the cases came into the hands of the surgeons, whether they were correctly diagnosed as tumours in the outpatient department, and admitted into the surgical wards ; or whether they were in the hands of the physicians for investigation for paraplegia and were then handed over to the surgeon.

A large number of cases sciatic pain, brachial neuralgia, wasting of the muscles of the hand had been examined by him to find out the cause and to exclude space occupying lesions of the cord.

Air-myelograms had been often done and although American authors claim good results, he had not been successful in spotting disc protrusions with this procedure. The co-operation of the radiologist was essential. Cases of industrial, occupational back-ache had been investigated (yearly 150 cases) for the past ten years. Three cases were suspected to have disc lesions but when admitted into surgical wards, they got better and refused operative treatment. History of injury, referred pains, paraesthesia, with muscle wasting and increase of protein in the C.S.F. were the criteria taken to diagnose a disc protrusion.

There were 7 cases of true tumours of the spinal cord, one case of hypertrophy of ligamentum flavum and two cases of failed laminectomies in which tumours were not detected.

Elsberg's method of spinal manometry was the routine in all cases of back-ache, tumour suspects

and sciatic pain. The amyl nitrite method was not used by him. With experience, spinal manometry becomes a useful method.

Comparison of cistern C.S.F. and L.P.C.S.F. and manometry is useful. Case No. 1 was a cord lesion, a neuro-fibroma, came through the physician as tuberculous disease of spine. C.S.F. protein was only 30 mg. %. Case No. 2 was mistaken for spinal syphilis because of positive Wassermann reaction and the presence of cells in the C.S.F. C.S.F. protein was 600 mg. %. Case No. 3 was mistaken for tuberculosis of the spine and hip ; the C.S.F. protein was 100 mg. %. The fourth case had positive C.S.F. Wassermann and was mistaken as spinal arachnoiditis ; the case was treated as spinal syphilis for a long time. The C.S.F. protein was 1,500 mg. % with 3 cells. The fifth case had been ill for twelve years under first class hospital physicians under various labels as peripheral neuritis, ichthyosis, progressive muscular atrophy and disseminated sclerosis. The C.S.F. protein was 80 mg. % on the first L.P. twelve years back and this should have aroused the suspicion of a spinal block.

The sixth case had neurofibroma on the back and rootpains. Three cases of multiple neurofibromata on the body with root pains have been investigated but a spinal block was not demonstrable. This does not really exclude a neurofibroma in the nerve roots or even cord. There are two specimens of multiple neurofibromata of the spinal cord in the pathology museum of the Madras Medical College, and they would have given rise to difficulties in diagnosis and also in finding out the lower limit of the tumours. In all the ten cases in this series only heavy Lipiodol through the C.P. route was used. An ascending Lipiodol to ascertain the lower limit of the tumour is also essential. Recent advances in the technique of lipiodol myelography enables one to take away the medium after the examination is over.

The seventh case was also treated for syphilis on account of the C.S.F. positive Wassermann. C.S.F. protein was 360 mg. %. The case of hypertrophy of ligamentum flavum was relieved after operation ; the C.S.F. was 30 mg. %.

Case No. 9 gave a history of syphilis ; serology was positive ; anti-syphilitic treatment was advised and given. Repeated examinations of L.P. every month showed an ascending curve of protein in the C.S.F. 20 mg. % first month, then 60 mg. % and then 30 mg. % with only 10 mg. % protein in the cistern C.S.F. There was a hold up of lipiodol but laminectomy failed to show a tumour. This patient is able to sit up but cord symptoms have not improved ; he had received 3 Mega units of penicillin and injections of bismuth ; his general health is good now, fourteen months after operation.

The tenth case was also a case of a young man who had a sore in the penis. He gave a history of sudden fall with retention of urine, treated by



suprapubic drainage in a District Headquarters Hospital. He improved subsequently, passed urine normally and was walking. His paraplegia returned and he came into this Hospital under the physician. He also exhibited C.S.F. protein increase in the L.P. month after month 40, 60, 80 with no cells, while cistern puncture protein was steady at 30 mg. %. C.S.F.W.R. anticomplementary. Blood W.R. was negative. After a stormy post-operative course he began to improve for a time and then his condition deteriorated and he died after four months. At autopsy a fusiform swelling of the cord lying between the 9th and 10th dorsal nerves was found. Section through the fusiform swelling showed a dilated cystic space 4 m.m. in diameter about 2 c.m. in length rather eccentrically situated near to the left of the central canal. Posterolateral to this was seen a cleft with dark yellowish pigment. Microscopic examination showed a large cavity with no definite ependymal lining with haemosiderin pigment along the wall. This case made one think of failed laminectomies. Wybury Mason's book on Vascular disorders of the Cord is a book worth reading: there are 68 cases of failed laminectomies recorded with clinical and autopsy notes. Vascular disorders of the cord are discussed in detail. All cases have to be examined for skin naevi or angiomas. Heart and aorta should be examined for congenital abnormalities; taking of a careful clinical history is essential; episodes and repeated attacks which may wax and wane are recorded.

All the cases met with were in the prime of life: this is in accord with the general findings and all were males although no special sex incidence is noted in world literature.

Considerable stress has to be laid on the fact that cases of root pain, paraesthesias, brachial neuralgias, sciatic pain, back-aches, referred pains, etc. have to be carefully investigated to detect early cases: spinal manometry according to Elseberg's technique is of great value.

Every clinical teacher should read out to his class and the students the first case of Gowers operated on by Sir Vicor Horsley on 4th July 1887. The case is so enlightening and has instructional value. A man of middle age first felt a peculiar pain in June 1884. It was localised in a spot beneath the lower part of the left scapula. It was increased by active exercise and by the jolting of a carriage. Repeated examination failed to reveal a cause for it. After a time it became less but was felt occasionally through the autumn and winter. In the spring he went to China on business and when he reached China it was so intense and so much increased by movements that he could scarcely walk. In October 1885, still suffering very much and very prostrate, he left China for England. During the voyage he improved in health: the pain lessened so that in December, 1885, he could walk a little. Walking had been interfered with only by pain. The improvement

continued and in the Spring of 1886 he went out of England on business. While there, the pain almost ceased. In September 1886 he returned to England, and the pain was again very severe. He became irritable and lost self-control; it was doubted whether the mysterious pain was as severe as he described and whether he was quite sane. By July 1887, he developed paraplegia, he had severe pain around the chest, a pain which increased in agony on any movement. Gowers noted a diminution of sensibility above the area. On July 4, he was operated on by Horsley and an enucleable tumour arising from the left dorsal root was removed. The patient recovered completely the use of his limbs.

They had at that time no facilities for x-rays, L.P., examination of C.S.F., contrast media, or serological examination. The clinicians examined cases fully and well and wrote down accurate notes and it is only by a full and methodical clinical examination of cases coming up for pain that cases can be spotted early.

Dr. V. M. Kaikini, gave a record of the following four cases:—

Case 1. V.M.M. admitted on 18-3-'41 for paralysis of both legs. About five months before the patient started getting pains in the loins and just below the umbilicus. About 15 days after the girdle pains he felt numbness and tingling in the soles of his feet, especially the left foot and felt it to be a little heavier than the right. Gradually loss of power occurred which developed into regular paralysis. On admission knee and ankle reflexes were lost on both sides, bed sores on buttocks, and cotton wool sensation was lost on the right leg and up to about two fingers below the umbilicus.

Lipiodol injection showed partial obstruction between the VIII, IX, X, II, XII dorsal vertebrae. Laminectomy done and spinal cord was exposed, after incising the dura mater. A soft elongated brownish looking tumour was extruded from the spinal cord. It was about 4" in length. Underneath the tumour was found a mass formed by varicose veins, which was carefully removed. The tumour removed was found to be neurinoma. The patient started feeling sensation of pins and needles on the third day. But the progress was not kept up and his condition gradually deteriorated and he died after about a couple of months.

Case 2. Mrs. D. admitted in Dec. 1929 for paraplegia of both the lower extremities due to a fall about eight months before. Radiogram showed fracture dislocation of 1st and 2nd lumbar vertebrae. Laminectomy of 12th D. to 4th L. vertebrae was done. A big sequestrum pressing on the cord was found in the region of the 2nd L. vertebrae. The sequestrum was removed. The patient started feeling sensation of pins and needles from the 8th day, and gained motor power in the legs after about three weeks. Her improvement was kept up

and now she is earning her livelihood as a teacher in an upcountry town.

Case 3. Male patient, aged about thirty. Admitted in 1933, for complete paraplegia of the both the lower extremities, due to fracture dislocation of the 11th and 10th dorsal vertebrae, due to a fall. Laminectomy was done and a good deal of fibrous adhesions were found at the site of the fracture. Some of the adhesions were removed but patient's condition did not improve.

Case 4. Male patient, aged 55. Admitted for paraplegia of both the lower extremities due to a fall. Laminectomy was done from 11th L. to 2nd L. After ten days the patient started getting power in the legs and the progress was kept up. After about three months the patient was able to walk about although some weakness was left in the lower limbs.

Dr. A. E. de Sa described two cases, one of a hypertrophy of the ligamentum flavum and one of a prolapsed intervertebral disc, in which persistent sciatics had been completely relieved by hemilaminectomy with removal of the space encroaching lesion of the spinal cord.

In the latter case the lipiodol myelogram indicated prolapse of the fourth disc, but the physical findings pointed to a lesion of the first sacral dermatome, which implied a prolapse of the fifth disc. It being well recognised that where there is a discrepancy between the clinical and radiological localisations, the clinical methods are more dependable, an exploration of the fifth disc was undertaken and a prolapsed disc removed with complete subsidence of symptoms. This case also demonstrated the interesting feature of almost total re-absorption of the 4 c.c.'s of lipiodol that were used in the myelography. A few oily globules in the sacral region of the subarachnoid space as demonstrated by x-rays, were the only evidence that remained of the myelogram, one year after myelography.

Dr. K. S. Nigam, gave an account of a case of spinal medullary tumour treated by laminectomy and spinal decompression with partial relief of symptoms early in his professional career in 1916. The biopsy material was examined by the pathologist and reported to be neurofibroma.

Dr. R. Mahadevan. The differentiation of intra-medullary from extra-medullary tumours by clinical findings alone as for, e.g. by the



Fig. 1.

Lipiodol X-Ray showing typical appearance of intramedullary spinal tumour, viz., partial block with laterally displaced beaded column of lipiodol.



Fig. 2.

Lipiodol X-Ray resembling spinal tumour in a case of syphilitic meningo-myelitis.

presence or absence of dissociated anaesthesia is not always easy. Indeed, in practice the differential diagnosis may be difficult or impossible (Walker, and others 1941). In such cases the myelographic criteria described by these authors may help. Reprint of skiagrams (Fig. 1) clearly brings out the typical and pathognomic appearances of an intramedullary tumour as explained by these authors, viz., a partial block with laterally displaced beaded columns of lipiodol streaking along the vertical pedicles for several segments. The beading represents the lipiodol in the sheath of the nerve roots. Thus the myelograms may help in establishing the diagnosis preoperatively. Intramedullary tumours usually involve several segments and this may be brought out by the myelogram and reveal the condition to be more extensive than the signs and symptoms indicated. Such a knowledge is of help to the surgeon,

- (1) to realise that a peculiar case is probably inoperable.
- (2) to give a guarded prognosis even if operation is considered possible, and
- (3) to plan his operation cognizant that the tumour is probably more extensive than the clinical findings indicate.

Fig. 1 shown here relates to a young lady of 35 years, who began experiencing increasing difficulty in walking. In the course of a few months she became completely bed-ridden and had sphincter disturbance also. The skiagram is suggestive of an intramedullary tumour. The question of operation did not arise as she refused any operative treatment.

The other skiagram shown in Fig. 2 relates to some very interesting features of another case—a case of meningo-vascular syphilis resembling tumour of the spinal cord. The patient, a Hindu male of 26 years, was admitted with paralysis of both lower limbs and retention of urine. Eight months prior to this trouble, he had received a few injections of arsenic in a local hospital, for a Hunterian chancre. A month prior to admission, he was practising horse riding and though he did not sustain any active injury, noticed soon after, pain in the hypogastric region and difficulty in walking, and suddenly became paralysed. At the time of admission there was flaccid paralysis of both lower limbs and the bladder was markedly distended. Lumbar puncture showed typical Froin's syndrome. Cistern puncture and Lipiodol introduction showed obstruction at the level of the 2nd dorsal vertebra. Both blood and C.S.F. W.R. were strongly positive. It was the opinion of Dr. R. V. Rajam, Veneral Specialist, General Hospital, Madras, whom I consulted, that though typical complete spinal block and Froin's syndrome are rare in syphilitic meningio-myelitis they do occur occasionally and that the case under consideration could be one such. A course of anti-syphilitic treatment inclusive of penicillin injections as suggested by him has brought gradual but considerable improvement to the patient though normal state has not yet been restored.

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## CARCINOMA OF THYROID AND ABERRANT THYROID

by S. P. SRIVASTAVA\*

The incidence of malignancy in the Thyroid varies between 1.5 and 3.5 per cent of the surgical diseases of the thyroid as reported from various clinics. The incidence was 2.7 per cent in the cases reported by Hardymon & Bradshaw from Winston Salem, North Carolina. Ward reports 3 per cent of malignancy and in the nodular variety 4.8 per cent. In Berne, Switzerland, the incidence of carcinoma is 10 per cent.

Thyroid malignancy occurs in the usual cancer age groups, i.e. about 45 years, except when malignancy occurs in the true or foetal adenoma or in aberrant thyroid tissue.

Lahey & Ward report that the highest percentage of malignancies which occur in aberrant thyroid tissue is in patients below 35 years.

One of my patients where the carcinoma is presumed to have developed in an adenoma was about 35 years old and the second one with aberrant thyroid about 20 years old. The third case was in the cancer age period, i.e. 50 years. All the three were females. One case of carcinoma thyroid reported by me in the Indian Journal of Surgery, Vol. IV, No. 4, was in a male aged 60 years with metastasis in the skull, ribs and pelvis. Other investigators have reported the ratio of malignancies as one male to four females. The University of California reports an incidence in the male of one malignancy for each 7 nodular goitres coming to Surgery. Lahey and Ficarra believe that lateral aberrant thyroids arise from ultimo-branchial bodies, the incidence being one in 500 goiters. They occur 5 times more often in women than men and all are either potentially or definitely malignant (papillary cyst adenoma or adeno-carcinoma).

Lahey lays stress that malignancy in aberrant thyroid tissue commonly occurs with papilliferous nodules in the lymphatic

glands which are actually metastases from the original cancer in aberrant tissue. The aberrant gland may be mistaken clinically, surgically and pathologically for involved lymph nodes in an advanced inoperable carcinoma of the thyroid. The tumours are multiple and painless, their growth being rapid or arrested for sometime. Associated with these lateral aberrant thyroid tumours there may or may not be carcinoma in the corresponding lobe of the thyroid gland. This view of the primary origin of carcinoma in the aberrant thyroid is contrary to that held by other thyroid surgeons. The association of malignant aberrant thyroids with a similar tumour in the corresponding lateral lobe of the thyroid has been known since 1903, when H. C. Low reported this fact. W. L. M. King and J. D. J. Pemberton regard the thyroid tumour as the primary carcinomatous lesion and the lateral lesion as metastatic. Emil Goetsch of Brooklyn has produced evidence to suggest that the carcinoma in more than 90% of cases is secondary to an adenoma of the thyroid. It seldom seems to occur as a primary lesion in the diffuse hyperplastic goitre of Graves disease. Where it did arise in such glands, it was found to have taken origin in a minute adenoma which had been obscured by the hyperplasia of the gland. He also points out that the existence of these adenomata in the hyperplastic gland of exophthalmic goitre is very rare. This accounts for the low incidence of carcinoma in exophthalmic goitre.

Allen Graham (Cleveland) from histological studies reports three types of malignancy :—

1. Papillary adeno-carcinoma—24 per cent.
2. Scirrhus carcinoma—1 per cent.
3. Malignant adenoma—85 per cent.

Hardymon & Bradshaw report 75 per cent of papillary adeno-carcinoma and 25 per cent of carcinoma simplex in their cases.

\*Dept. of Surgery, Agra Medical College.

Dunhill has pointed out that the very beginnings of malignancy have to be recognised in a simple adenoma and an accurate histological examination is essential.

Invasion of blood vessels is of diagnostic and prognostic significance. Other definite evidences of malignancy are usually found at the operating table in the form of invasion of the capsule of the adenoma or thyroid gland, of the lymphatics or of the pretracheal muscles. In all the three cases reported here the histological diagnosis was malignant adenoma, showing the origin in adenoma of the thyroid. The aberrant thyroid enlargement also showed adeno-carcinoma on biopsy.

A. Bianchi reports that the papilliferous structure may be found both in carcinomatous and non-carcinomatous aberrant thyroids. To differentiate this a careful histological study of the cells is required and capsulation of the tumour and invasion of the blood vessels taken note of. Some papilliferous structures in the lymph glands have their origin from malformed pharyngeal tissue as, in the latter, epithelial and lymphoid tissues are present side by side in the embryo. The presence of a fibrous capsule between the papilliferous structure and the lymphoid and thyroid tissue is of diagnostic importance as it indicates whether one is dealing with a malformation or a metastatic lesion.

#### SYMPTOMS AND DIAGNOSIS

It is difficult to diagnose carcinoma, more so that of the aberrant thyroid, in the early stages. Cases may present themselves as adenoma clinically and the histological examination may show them to be carcinomatous. Case No. 2 presented herself with a lump in the right lobe of the thyroid gland, which started growing rapidly within the last one year. Clinically there was no indication of malignancy except that she was slightly anaemic and the swelling had started growing rapidly in the last few months. On operation the growth was adherent to its capsule and very vascular. Similarly the case of aberrant cancer of

thyroid presented herself with a soft lump beneath the right sternomastoid muscle, the thyroid gland being only slightly enlarged like a puberty goitre. If the patient comes in the late stages, as in Case No. 3, there may be enlarged lymphatic glands on the side of the neck and pressure effects, for example, dysphagia and dysphonia (due to pressure on the recurrent laryngeal nerve and not due to its involvement by carcinoma). Recurrent laryngeal nerve paralysis is one of the three cardinal signs of malignancy, the other two being fixation due to infiltration of trachea and pretracheal muscles, and hardness.

In Case No. 3 the patient, an old woman, had a very hard infiltrating growth of the thyroid with hard fixed lymphatic glands on the left side of the neck. A cold abscess had formed due to degeneration and infection of the glands. There was difficulty in swallowing and alteration in voice, i.e. hoarseness. Such a case cannot be missed being diagnosed as carcinoma. It is rather unlucky from the treatment point of view to get cases at this stage. None of my cases showed any sign of thyro-toxicosis. The percentage of toxicity was 16.6 per cent, i.e., 2 out of 12 patients reported by Hardyman & Bradshaw. The primary tumour of the thyroid may be small or unnoticed and a patient may come with a metastatic growth in the bones or a pathological fracture.

#### TREATMENT

If local signs of malignancy are advanced no operation should be undertaken. If the condition is early and slow in progress, operation does hold out a good hope of complete cure. The fact that most of the cases of carcinoma are secondary to adenoma is a strong point in favour of removal of all adenomata and subjecting them to microscopic examination. Walton points out that if adenoma has given rise to hyper-thyroidism it is more likely to become carcinomatous.

In his opinion contra-indications to operation for carcinoma of thyroid are a rapidly growing tumour of large size with sur-

rounding dilatation of vessels and wide infiltration of muscles with evidence of involvement of trachea by the presence of cough and blood stained expectoration. If the tumour of the thyroid is slow growing and small with a secondary metastasis which can be removed by amputation, etc. operation has been advised.

**Choice of operation:** If there is an adenoma localised to one lobe it is removed along with some healthy thyroid tissue, or hemithyroidectomy may be done. If the pre-tracheal muscles are adherent they should be removed freely along with the thyroid glands. In Case No. 2 there was no suspicion of malignancy till the whole tumour was removed and examined macroscopically, and microscopically. Thus many of the cases are diagnosed during the routine biopsy of enucleated adenomas. If the thyroid contains several adenomatous masses only one of which is clearly carcinomatous or there is a diffuse growth total thyroidectomy should be done with removal of lymphatic glands if any, and the muscles and the internal jugular vein of one side. Myxoedema can be controlled by small doses of thyroid extract and no risk should be taken of leaving any suspicious tissue behind.

**Treatment of Carcinoma of Aberrant Thyroid:** The treatment recommended is wide exploration of both sides of the neck with removal of all aberrant tissue as well as lymph glands and resection of any part of the thyroid which appears enlarged. Clay and Blackman recommended removal of the homolateral lobe of the thyroid which may or may not be carcinomatous along with the aberrant glands and block dissection of the same side of the neck. Deep x-ray therapy is advised after the operation and the lesions are reported to be of low malignancy and radio-sensitive. Joll & Lahey advise the same operation as above, i.e., removal of aberrant glands with block dissection of the same side of the neck and the lateral-lobe of the thyroid gland of the same side. The internal jugular vein and even the sternomastoid muscle are removed, provided the lymphatic glands are adherent. In case No. 1 aberrant thyroid was detected during

the enucleation of the tumour and the two adjoining glands which were removed also looked like thyroid tissue. The latter were found to be lymphatic glands infiltrated with carcinoma on biopsy. The corresponding lobe of the thyroid gland appeared to be healthy on palpation and was not removed. Deep x-ray exposures were given after operation. There was slight exacerbation of symptoms with swelling of the side of the neck but it later subsided and the patient improved considerably.

Deep x-ray is very helpful in inoperable cases of carcinoma thyroid and also after an operation of subtotal or total thyroidectomy specially when it is uncertain that all the growth has been extirpated. The results of deep x-rays are more satisfactory and effective than those of radium.

Case 1. S.D., Female, aged 18 years was admitted with the complaint of swelling on the right side of the neck. Duration was about 4 years. The patient was a healthy young girl with no anaemia or any other glandular enlargement elsewhere. On examination 2 glandular lumps were felt beneath the upper third of right sternomastoid muscle. The lumps were soft to feel and discrete. There was slight fullness in the right supraclavicular region. The thyroid gland was only very slightly enlarged giving a slight suspicion of a puberty goitre. She was diagnosed to be a case of enlarged tubercular glands of the neck and on that presumption the operation was decided upon. On exploration the lump was found beneath the upper portion of the sternomastoid muscle which was divided. What appeared clinically a caseous gland turned out to be a lump of aberrant thyroid 3 inches by 3 inches in size with extreme vascularity. It was enucleated along with two smaller lumps which also looked like thyroid tissue. The latter were densely adherent to the surrounding tissues especially the internal jugular vein. The cut sternomastoid was sutured and interrupted skin sutures were applied. The wound healed by primary intention (Fig. 5).

**Histological diagnosis:** Adeno carcinoma of aberrant thyroid Fig. 1. The smaller lump was a metastasis in the lymph gland as the section (Fig. 2), shows adeno-carcinomatous tissue surrounded by lymphoid tissue. There was no lymphoid tissue in the big lump showing that the carcinoma arose primarily in the aberrant thyroid and not in the main thyroid gland which appeared normal on the operation table. She had 10 exposures of deep x-ray, i.e. a total dose of 1800r units after the operation. She is still under observation.

Case 2. F.B., aged 30, female, complained of a swelling of the neck of the size of a tennis ball. Duration of the swelling was 12 years and lately it



Fig. 1.

Adenoid-carcinoma of Aberrant thyroid removed from beneath the right sternomastoid muscle size 3" x 3". (Case 1.)



Fig. 3.

Adenocarcinoma of thyroid—a lump of the size of a tennis ball removed from the right lobe of the thyroid gland. (Case 2.)



Fig. 2.

Carcinomatous metastasis from aberrant thyroid into a lymphatic gland. The area of malignant infiltration is surrounded by a capsule of lymphoid



Fig. 4.

Adenocarcinomatous goitre—biopsy done in a case of inoperable carcinoma of thyroid with metastasis in the cervical glands. (Case 3.)



began to grow rapidly and caused difficulty in swallowing and breathing. The patient was slightly anaemic. There were prominent veins over the neck and the swelling was hard and well defined and moved slightly on deglutition. There were no glands palpable on the side of the neck. There were no signs of toxicity. Pulse was 85 and blood pressure was normal.

**Operation Notes :** The operation was done under local anaesthesia. The lump in the thyroid was exposed by a collar incision after dividing the pre-tracheal muscles. The right and left superior and right inferior thyroid arteries were ligatured along with the right middle and inferior thyroid veins. The capsule appeared to be thick and adherent and the vascularity was marked. The lump involved the right lobe, isthmus and a large part of the left lobe of the thyroid gland and was enucleated *in toto*. On cutting the lump it showed blackish brown areas of degeneration and gelatinous tissue all round. The lump was well surrounded by a capsule which was not adherent to surrounding structures. She had 500 c.c. of saline with 5% glucose within the first 48 hours. The wound healed by primary intention.

**Histological diagnosis :** Adeno-carcinoma of thyroid (Fig. 3). She was advised to get deep x-ray exposures. She was given injections of liver extract and plastules by mouth for anaemia.

**Case 3. K. W. aged 50 years, Hindu female** complained of (a) bilateral swelling in the neck with pain and difficulty in deglutition. (b) a soft swelling in the left supraclavicular region.

**Duration :** She had the swelling for the last 5 years; it had been increasing in size gradually since then.

**Local examination :** Both the lobes of the thyroid gland were enlarged and hard in consistency. The left cervical glands were enlarged and matted together. There was a cystic swelling in the left supraclavicular region was slightly hot to touch and red in colour. The patient was an old lady in a weak state of health and slightly anaemic. Pulse was 90 p.m. and temperature normal. There were no signs of hyperthyroidism. Blood examination: Total W.B.C. 8400 per c.m.m. Differential count: Polymorph 72%, Lymphocyte 28%, Eosinophil 0%. Total R.B.C.—3 million per c.m.m. H.B.—9.5 grams per 100 c.c. Aspiration of the cystic swelling was done and pus was withdrawn. Examination of pus revealed the presence of pus cells in large numbers and no micro-organisms. Culture showed contamination.

A small adenomatous nodule of the left lobe of thyroid gland of the size of 2 in. x 2 in. was removed for biopsy.

**Report of Biopsy :** Adeno-carcinomatous goitre Fig 4. This case was one of adenocarcinoma of the thyroid with metastasis in the left cervical lymphatic glands. Some of these had undergone degeneration with infection giving rise to a cystic swelling.



Fig. 5.

Aberrant thyroid on the right side of the neck excised in a girl 18 years old.

She had 10 exposures of deep x-ray of 200r units each. The swelling subsided to a great extent and she was advised to come again for deep x-ray.

### Summary

1. Incidence of malignancy of thyroid and aberrant thyroid in the literature is reviewed.
2. The pathology of carcinoma of the thyroid and of the aberrant thyroid is described along with diagnosis and treatment.
3. Two cases of carcinoma of the thyroid and one of aberrant thyroid are reported along with micro-photographs.

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# MEDIASTINAL TUMOURS

by D. K. SABESAN\*

Mediastinal tumours are only rarely encountered and often they are not amenable to surgical extirpation; with improvements in modern anaesthesia methods with availability of positive pressure anaesthesia, the dangers of opening the pleural cavity and sudden mediastinal shift have disappeared; and the better understanding of methods of combating fluid loss and protein replacement have made many of these tumours operable. They may be solid or cystic, innocent or malignant and arise from connective tissue elements or epithelial tissues; fortunately it is now recognised that the majority are benign and encapsulated and if diagnosed early are amenable to surgical extirpation.

## (1) Benign Tumours:

### A. Cystic.

1. Bronchogenic
2. Dermoids
3. Pericardial
4. Hydatid cysts.

### B. Solid.

1. Fibroma
2. Neurofibroma
3. Ganglioneuroma
4. Lipoma
5. Chondroma, Chondromyxoma
6. Xanthoma.

## (2) Malignant Tumours:

1. Lymphosarcoma
2. Bronchogenic carcinoma
3. Hodgkin's disease
4. Neuroblastoma or  
sympathico-blastoma
5. Thymoma.

### (1) Benign Tumours:

#### A. Cystic.

*Bronchogenic cysts* or tracheo-bronchial cysts arise from foregut diverticula near the

tracheal bud and their walls are composed mainly of fibrous tissue and may contain mucous glands, cartilage or smooth muscle; they are lined by stratified squamous epithelium. They remain in contact with the trachea or main bronchi; they may attain a considerable size. These give rise to symptoms only when they are big—chest pain, cough, dyspnoea. Radiologically they give a smooth globular opaque shadow in the mediastinum.

*Dermoids* arising anteriorly in the superior mediastinum, behind the sternum tend to spread laterally and extend into one or both lung fields; they may not be noticed for a long time and are often seen only in adult life. These tumours arise from cell rests and sometimes elements of all layers may be present in their structure. As they frequently enlarge rapidly and may become infected, they are serious; they may burst into the air passages and also involve the skin, so may give rise to fistula formation. Dyspnoea and cough first attract attention; pain in the upper part of the chest is not constant; the sputum may reveal sebaceous material, hair, teeth, etc., they often give rise to haemoptysis and there may be enlargement of veins in the neck near the thoracic inlet. They give a clear well-defined globular smooth-walled shadow, situated near the middle line above the pericardium.

*Pericardial cysts*: Usually give rise to no symptoms. They arise similar to the above; they are in contact with the anterior chest wall. They are only detected on routine x-ray examination of the chest.

The three tumours mentioned above are capable of complete surgical excision by mediastinotomy with sternal split, if necessary.

*Hydatid cysts* are rare. They are treated by excision of the lining membrane of the cyst and drainage.

\*Gen. Hospital, Madras. The author is indebted to the Pathology Dept. and the X-ray Dept. for valuable help rendered.

## B. Solid.

*Fibromata* are rare. They do not attain a large size and do not cause any symptoms. They are accidentally detected on routine radiological examination for some other chest complaint.

*Neurofibromata* arise from the sheath of a thoracic spinal nerve. Occasionally arising from in front of the neck, from a cervical nerve, they may grow down into the chest. They usually occur in the posterior mediastinum. When they arise in the intervertebral foramen, they may extend both into the spinal canal as well as into the thorax getting an hour glass shape. When purely intra-thoracic they remain symptomless for a long time. But when there is an intraspinal protrusion, symptoms of spinal cord compression occur early and so come to the notice early. They may occasionally become malignant.

Note.—Case No. 2 reported below is a neurofibroma showing sarcomatous degeneration.

*Ganglioneuromata* arise from the thoracic sympathetic ganglionic chain. They occupy the posterior mediastinum; they are firm lobulated tumours and microscopically show a reticular network containing groups of multi-polar ganglion cells but are spotted earlier than neurofibromata as Horner's Syndrome appears early.

*Lipoma* is rare. It may be purely intra-thoracic or be connected by an isthmus through the chest wall to an extra thoracic portion or protrude into the neck through the thoracic inlet. It is of slow growth and may attain a large size, when it may give rise to pressure symptoms.

*Chondroma* and *Chondromyxoma*: These tumours primarily arising from the ribs and their cartilages, from the sternum or vertebral column, may project into the mediastinum. They are encapsulated, sharply defined nodular tumours but may become malignant. Pain is an early symptom; the external mass or lump draws attention to its situation as do the seat and

character of the pain. They may give rise to mediastinal compression, suffusion of the face, cyanosis, hoarseness, dysphagia or pressure on the sympathetic trunk. X-ray shows a circumscribed shadow with an origin in the bony thorax.

*Xanthoma*: *Xanthoma* is rare. It is benign and operable. Blood stained pleural effusion is reported to be present in the operated cases from the literature.

## (2) Malignant Tumours:

*Lymphosarcoma* is the commonest malignant tumour; occurs in adults, between the ages of 30 and 50 and twice as common in males as in females. It gives rise to pain and swelling and mediastinal compression early; cough, dyspnoea, haemoptysis, and low-grade fever are usually present. The physical signs in addition to those of a lump in the chest include a swelling in the supra-clavicular fossa on one side of the sternum. It is highly malignant and proves fatal very early. It is sensitive to deep x-ray and palliative treatment is the only remedy.

*Bronchogenic Carcinoma* or the "Superior Sulcus Tumour" arising from the front of the root of the neck, extends into the superior mediastinum through the thoracic inlet. It is a well defined lobulated tumour, hard and fixed and gives rise to early pressure symptoms. Early Horner's syndrome and brachial neuritis are special features.

This tumour may be extirpated surgically, if diagnosed early.

*Hodgkin's disease* is mentioned as the aetiology of the glandular enlargement is still uncertain. Enlarged mediastinal glands may form a nodular lump straddling the trachea in the superior mediastinum and may exert pressure symptoms. It is radio-sensitive and suitable for palliative treatment only.

*Neuroblastoma* arises from embryonic nerve cells, occurs in children and is highly malignant. Treatment is of no avail.

*Thymoma* is primarily a malignant tumour of the Thymus. The tumour may

arise from the lymphoid or reticulum cell and histologically resembles lymphosarcoma or carcinoma. It gives rise to progressive mediastinal compression, pleural effusion and rapid cachexia; some cases show symptoms of myasthenia gravis; x-rays reveal a lump in the mediastinum—irregular dense shadow at the thoracic inlet. It is radio-sensitive and only palliative treatment is possible.

The diagnosis of mediastinal tumours is not always simple. Other conditions like retrosternal goitre, aneurysms of the pulmonary artery and thoracic aorta—ascending arch and descending parts, enlarged tuberculous glands in the mediastinum have to be excluded. A careful examination for evidence of pulsation at the root of the neck, tracheal tugging, examination of the blood for Wassermann and watching the movements under a screen while swallowing a barium meal will help in the differential diagnosis. In spite of all the above investigations, the diagnosis is often uncertain and many disappointments may have to be faced during thoracotomy.

The following cases will illustrate the difficulties in diagnosis:

- (1) Bronchogenic Carcinoma—"Superior Sulcus Tumour".
- (2) Neurofibroma showing sarcomatous change.
- (3) Aneurysm of the thoracic aorta.
- (4) Hyperplastic tuberculosis of the cervical and mediastinal glands.
- (5) Lymphosarcoma of the mediastinum.

The case reports of these five are herewith enclosed.

### CASE REPORTS

#### (1) BRONCHOGENIC CARCINOMA

Mustan, Mohammadan, aged 53, dry fish trader by occupation, complained of cough, dyspnoea and pain in the right upper chest and right upper arm of 3 months' duration. He was exceedingly debilitated, anaemic and cyanosed. Examination revealed fullness in the right supraclavicular fossa and right upper chest and sternum; there was visible turgescence of the veins at the root of the neck; parasternal dullness in the 1st and 2nd right inter-space close to the sternum with hollow bronchial

sounds and dullness over both hilar areas with feeble breath sounds were present.



Fig. 1.  
Skiagram of Bronchogenic Carcinoma. The tumour is irregular and is seen extending from the mediastinum into the right hilar region.

X-ray examination (Fig. 1) showed an irregularly globular densely opaque shadow on the right side behind the trachea, with miliary mottling of both lung fields; barium swallow and screening showed the tumour occupying the anterior and superior mediastinum, non-pulsatile, with no barium impression on the shadow.

Patient perspired whenever he got pain in the chest, and this was more marked on the right side. His pupils were equal, normal and active; the radial pulse rate was 136 per minute on the right side, and 130 on the left side.

#### INVESTIGATIONS

- (1) E.N.T. Examination: Normal.
- (2) W.R. and Kahn: Positive.
- (3) Blood count: R.B.C.—3.12 millions.  
W.B.C.—8800.  
Haemoglobin—59%.  
Differential count: Polymorphs—65%.  
Lymphocytes—30%.  
Eosinophils—5%.
- (4) Weight: 73 lbs.
- (5) Urine: S.G. 1008.  
Reaction: acid.  
Sugar: Nil.  
Albumin: Nil.

(6) Lange's Gold test: Negative.

(7) B.P.: Right arm—140/80.

Left arm—150/100.

The case was referred by the physician and I considered it to be a malignant 'superior sulcus tumour' inoperable and advised deep x-ray therapy. 19/2—He was put on this treatment; but steadily got worse—pain, dyspnoea and cyanosis getting worse. The case was discussed at the General Hospital Clinical meeting; the physicians and radiologist were of opinion that it was a radio-insensitive tumour—probably a ganglioma and prevailed on me to undertake surgical extirpation.

A preliminary pneumo-thorax was done on 1-3-'48 and 450 c.c. of air put in and repeated on 4-3-'48 putting in 600 c.c.; the collapse was not satisfactory, his condition remained the same. He was therefore transferred to the surgical ward under my care.

On admission his weight was 73 lbs., R.B.C. 3.5 million, Hb. 55%, B.P. right arm 100/75, left arm 110/80, pulse rate right 106, left 120. Patient was slightly cyanosed.

Operation—10-3-'48. *Exploratory major-intercostal thoracotomy.* Under intratracheal  $N_2O$ ,  $O_2$ , and cyclopropane with local skin infiltration with  $\frac{1}{2}\%$  novocaine and intercostal nerve block 2" of the 4th and 5th ribs near the transverse processes were resected posteriorly and the pleura incised along the full length of the incision along the 4th intercostal space; ribs retraced; exploration revealed an irregularly globular infiltrating tumour adherent to the right lung and firmly fixed to the medial and posterior mediastinal structures. The lung had not collapsed. As manipulation led to circulatory depression, the chest wall was closed without drainage and further steps postponed. Blood transfusion was given during the operation and he was put on parenteral penicillin. Patient developed pulmonary oedema next day and after a stormy convalescence for 3 days, his condition improved rapidly.

On 14-3-'48 his pulse rate was 115 per minute; breathing considerably easier; respiration 28 per minute, B.P. 90/70.

On 24-3-'48 a second operation was performed with local skin infiltration and intratracheal  $N_2O$ , and  $O_2$ . The old incision was opened up and adhesions to the lung on the lateral side separated by blunt dissection. The adhesions on the posterior, inferior and superior aspects were freed by gauze dissection and a broad pedicle obtained at the medial vertebral end of the tumour. This was clamped and the tumour removed after ligating the pedicle. The bleeding was negligible and there was no pleural soiling. After local instillation of penicillin the chest wall was closed with a drain at the medial end of the incision. Blood transfu-

sion was given during the operation (350 c.c.). Patient stood the operation well. His subsequent progress was satisfactory. At the end of 72 hours, the drainage tube was removed. On the 10th day, stitches were removed. Three days later, posterior end of the wound gave way and discharged thin offensive serous fluid.

The patient is now free from pain or dyspnoea but he is still very weak and unable to sit up. There is a considerable amount of serous discharge.

On 12-4-'48 the patient was discharged at his own request.

#### PATHOLOGICAL REPORT

Appearances are suggestive of epidermoid carcinoma probably bronchogenic (Fig. 2).



Fig. 2.

Bronchogenic Carcinoma, epidermoid pattern.

#### (2) NEURO-FIBROMA SHOWING SARCOMATOUS CHANGE

A Hindu, male, aged 22, attender by occupation, was admitted to my wards on 1-11-'47 with a complaint of swelling in the right side of neck and chest and harshness of voice since 2 months.

Previous illness or injuries: Nil relevant. No trauma; he has been having a dry cough since 3 months.

Present illness: Two months back, he casually noticed a lump of the size of a lime in the right supraclavicular fossa. Painful only on pressure. Later he noticed a change in the voice. He consulted a private doctor; got five x-ray exposures and took some pills, daily for 5 days. The swelling reduced and the voice improved. A fortnight later, the swelling increased, voice became husky again, and so he came to the hospital.

General condition on admission: Poorly nourished, weight 96 lbs., height 5 ft. 7 inches,

chest asymmetric, tall and thin, slightly anaemic, pyorrhoea present.

Local condition: (Fig. 3 & 4). Prominent swelling over the medial half of the right clavicle with fullness of the right supraclavicular fossa and fullness of the right side of the chest upto the nipple line. A corresponding bulge was also seen on the back over the right inter-vertebral space. The skin over the swelling was not stretched or shining; no prominent veins over the swelling. The neck swelling extended upto the posterior border of the sternomastoid and did not move with deglutition; both inner ends of the clavicles could be moved up and down; an ill-defined bony mass could be palpated at the first costo-chondral junction; the thyroid gland was normal except for the right side fullness. The trachea was displaced to the left at the root of the neck. The radial pulse was equal on both sides and of normal volume and tension. The pulse rate was 108, there was no respiratory distress or cyanosis; no tracheal tug-

ging felt. Both pupils were equal and reacting to light and accommodation. Patient had a brassy cough with scanty mucoid expectoration and voice was very hoarse being little more than a whisper.

Patient had a scoliosis with marked convexity to the left. The muscles of the right shoulder girdle were slightly wasted and the right scapula appeared to be on a higher level. The arm and forearm muscles were however normal and equal; no fibrillary twitchings. Power and tone normal; reflexes normal. No sensory disturbances. Chest examination nil abnormal except for diminished breath sounds over the base but no adventitious sounds. Heart sounds normal.

#### LABORATORY INVESTIGATIONS

Urine: Sp. gr. 1012, sugar nil, albumin nil.

Blood R.B.C. 4.2 million, W.B.C. 8200, Hb. 80%.

Blood sedimentation rate: 8 mm. at 45'.  
35 mm. at 45'.

Blood W.R. and Káhn negative.

Blood pressure: Systolic 130, Diastolic 85.



Fig. 3.

Anterior view of the patient before operation. The medial ends of the clavicles are prominent and the tumour is filling up the right supraclavicular fossa.



Fig. 4.

Same patient. Lateral view.

Myocardial Index—40 seconds.

Sputum: Negative for acid fast organisms.

Concentrated method: Negative for acid fast organisms.

No malignant cells in the sputum.

B.M.R. plus 1.8%.

Examination of larynx: Middle line paralysis of right vocal cord.

X-ray of the chest: Fig. 5.

Operation: Preliminary transfusion of whole blood 17-11-'47 300 c.c. and vitamins B & C.



Fig. 5.

Skiagram of the chest. The neurofibroma has a regular contour, occupying the mediastinum, the right pleural cavity and the root of the neck.

Operation 1-12-'47, under gas, oxygen and intratracheal cyclopropane. Anterior mediastinotomy. A low collar incision was made, pre-laryngeal muscles divided and a globular encapsulated pedunculated tumour was revealed. The pedicle which appeared to be attached to the thyroid isthmus was divided between ligatures and an effort made to enucleate the tumour within the capsule. This was ineffectual as the tumour was very big and the lower pole could not be reached by the finger; a vertical incision was made in the middle line of the chest and the sternum was split right up to the junction of the body with the ensiform; the split-edges were widely refracted and the tumour was shelled out of its capsule; the lower portion of the tumour appeared to be undergoing mucoid degeneration and was easily separated from the capsule. The rest of the tumour was hard and heavy. There was only slight oozing from the bed; the pleura was not damaged;

wire sutures and the skin wounds were closed with interrupted sutures. A small rubber-dam drain was left at the centre of the collar incision. (Specimen was 15 c.m. long and weighed 280 grams.)

During the operation the patient was given 700 c.c. of blood.

Post-operative convalescence: A saline drip was instituted for 24 hours and patient put on penicillin 20,000 units three-hourly for 6 days. There was a moderate rise of temperature of 102° for 4 days and the patient had cough and profuse ex-



Fig. 6.

Post-operative skiagram of the chest showing the unexpanded lung on the right side.

pectoration of frothy mucopurulent sputum. Oxygen was administered through a B.L.B. mask. Physical examination showed no air entry in the right base and axilla, and this region was tympanitic on percussion. The drainage tube was removed at the end of 48 hours. The temperature came down on the 5th day to normal and thereafter for a few days showed slight evening rise of about 1 degree in the afternoon. On the 10th post-operative day, patient was completely afebrile and stitches were removed and the wound had healed by first intention. Chest examination still showed deficient expansion of the lung on the right side over the tumour area and x-rays confirmed this (Fig. 6). There was no dyspnoea or respiratory distress however. The pulse rate was 80 and respiration 20 per minute. The voice though improved was still hoarse. His general condition showed steady improvement (Fig. 7) and periodical x-rays revealed gradual expansion of the lung.



Fig. 7.

Mediastinal neurofibroma Patient after operation



Fig. 8.

Neurofibroma of the mediastinum. Section of the tumour shows a well-defined capsule and yellowish white necrotic areas in the centre.

Gross Pathology—Fig. 8.

Microscopic Pathology—Figs. 9-a & b.

### (3) ANEURYSM OF THE THORACIC AORTA

Mr. Appa Rao, age 35, H.M., was admitted to my ward on 7-9-'47 for pain in the left chest of one

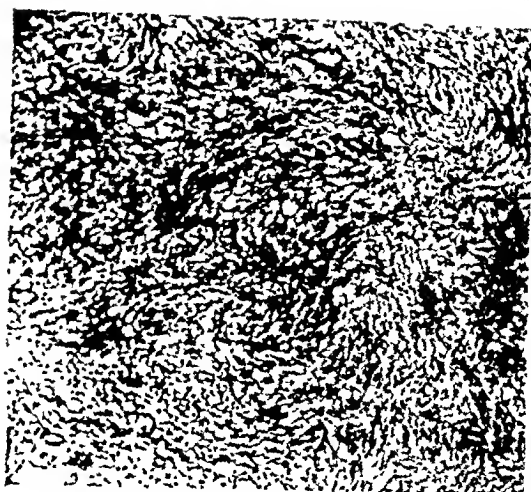


Fig. 9-a.



Fig. 9-b.

Fig. 9-a. Neurofibroma of the mediastinum showing 9-b sarcomatous change.

years's duration. He gave no history of trauma or exposure to V.D. At the onset, it was a dull aching pain, worse at night and felt in the left mid-axillary and posterior scapular regions gradually it got worse and radiated to the front. He had no cough, dyspnoea or cyanosis; appetite was good, bowels were regular but sleep was disturbed. His general nutrition was good, not anaemic. The chest was well-developed but showed a bulge in front just above pericardium; the apex beat was normal in the left fifth interspace in the nipple line; the left border of the heart was half an inch lateral; there was no abnormal pulsation in the supra-sternal notch; no tracheal tugging, the radial pulse was equal on both sides—82 per minute; Traube's space was not obliterated; chest showed impaired resonance over the left II, III and IV interspace and sternum in front; the

breath sounds were diminished and there were no adventitious sounds; no Horner's syndrome; left jugular vein was prominent in the neck; X-rays—A.P. view showed a globular shadow encroaching to the left mid-line opposite to the II, III and IV space and extending to the left nipple line. The lateral view showed an opaque shadow above the pericardium and apparently not continuous with it.

Oblique view: Suggested that the tumour was anterior to the pericardium.

Screening: With barium swallow, showed the tumour to be well in front of the heart.

#### INVESTIGATIONS

Blood: W.R. and Kahn—strongly positive, done on 13-9-47.

Blood: Total W.B.C. 5300.

B.P.: Right arm 105/70. Left arm 100/70.

Pulse rate: at rest 82 per minute; equal on both sides.

In view of the strong positive W.R. and Kahn, the diagnosis was in favour of aneurysm of the arch of the aorta, in spite of there being no hoarseness, tracheal tugging or pulsation in the suprasternal notch or upper part of the chest; but the possibility of a simple cystic tumour in the superior mediastinum was borne in mind.

#### TREATMENT

Put on penicillin treatment; had 1 mega unit in 8 days; there was no change in his condition. He was therefore put on bismuth and potassium iodide and vitamin C;  $\frac{1}{2}$  c.c. of bismuth with 10 c.c. of sodium iodide and vitamin C once a week. With antisyphilitic treatment, patient's condition improved, his pain diminished, slept better and the bulging over the pericardium diminished.

Patient discharged at his own request: advised to report after a month.

#### (4) TUBERCULOSIS CERVICAL & MEDIASTINAL GLANDS

S. A. Khader, Muslim, aged 29, sub-inspector of police by occupation, admitted for swelling mid-line of neck of 4 months' duration.

Family history: nil particular.

History of present illness: gradual onset: no fever, cough, or dyspnoea. No cyanosis, no pain.

No prominent veins in the neck. No pulsation over root of neck. No tracheal tugging. Voice normal. Lump size of a marble (? moves with deglutition)—globular; cystic. Pressure over and hyperextension does not cause any difficulty in breathing; Lump (?) is in the region of mid-line extending over to right side. 2 adenomatous nodules felt—one near the isthmus and the other in the right side. No toxic symptoms. Pulse rate 80; slight ptosis of the eye lids. Heart boundaries normal.

X-ray: opaque globular shadow in the superior mediastinum in the mid-line and to the right.

Screening: Tumour with convexity downwards is visualised in the right side of sup. mediastinum below right clavicle which moves upwards with deglutition. Suggestive of retrosternal goitre.

#### INVESTIGATIONS

H.B. 85%.

W.B.C. 8800. R.B.C. 4.25 millions.

B.M.R. 7.4%.

Kahn—positive.

Blood pressure: 105/65.

Urine examination: Sugar—nil. Albumin—nil.

Weight: 112 lbs.

Operation: Excision of caseating tub. glands (lymphatic) in front of the thyroid: burst during dissection.

Sutures removed: wound healed by 1st intention.

Post-operative: U.V. ray treatment was given.

#### (5) LYMPHOSARCOMA OF THE MEDIASTINUM

A male aged 30 was admitted to the medical ward with severe respiratory distress and with other signs of increased thoracic pressure. A large irregular swelling, firm and adherent to the deeper structures was present extending from the superior mediastinum into the root of the neck. A palliative mediastinotomy was done and a small portion of the tumour was removed for histological examination. Patient expired 24 hours after operation. The histological diagnosis of the tumour was lymphosarcoma of the lymphocytic type.



## CASES & COMMENTS

### HYDATID CYST OF LIVER WITH EXTENSION INTO THE ABDOMINAL CAVITY

by S. P. SRIVASTAVA\*

The liver is the commonest site of infection by *Taenia echinococcus*. The next common site is the lung. Bilateral pulmonary hydatid infection has been recorded by A. L. Dabren and Lambert Rogers<sup>2</sup>. Hydatid infection of the kidneys was first reported by Davies at the end of 17th century and then again by Campbell Begg of New Zealand<sup>1</sup>. Hydatid cyst of the uterus has been reported by G. L. Langly<sup>3</sup>. Knee-bone has reported the frequency of this disease in the different parts of the body in an analysis of 59 cases (liver 35 cases, lungs 16 cases, pelvis 4 cases and subcutaneous tissue, one case). N. Ross Smith<sup>4</sup> of Bournemouth has reported one case of pedunculated hydatid cyst of the liver. In the subcutaneous tissues, muscles and bones it is least common. G. Onlic of Constantine has given a report of 152 personal cases. Cyst of the liver has been described as usually multiple, lying dormant for long periods and multiple stage operations have been advised to avoid any risk to the patient. He advises exposure of the cyst when it lies nearest to the surface; 124 cases were exposed through the abdomen, 29 through the diaphragm after rib resection. He advises aspiration of the cyst, injection of formalin and removal of the contents of the cyst; the cavity is then dried with ether and closed with drainage. The general peritoneal cavity is shut off by sewing the liver to the abdominal wall. If the cysts are large, multiple, calcified and suppurating, marsupialisation and drainage is better.

Hydatid cyst of the liver sometimes bursts into the bile duct causing obstructive jaundice, in which case G. Garayamaopoulos of Athens advises opening of the duct and drainage of the cyst. He has

reported 8 cases with one death. The ova of *Taenia echinococcus* are conveyed by the portal circulation; so 75 per cent of all hydatid cysts affect the liver and when hydatids are present in other organs, for example lungs, the liver is affected in 50 per cent of the cases. The right lobe of the liver is more commonly affected than the left, the ratio being 4 : 1. Cysts near the peritoneal surface spread towards the abdominal cavity, become pedunculated if rising from the free border and elevate the diaphragm when occurring on the superior surface. If they occur in the bare area they may extend into the retroperitoneal tissues.

Probably in the case referred to here, the cyst arose in the bare area and then extended downwards into the retroperitoneal tissues, thus displacing the abdominal contents forwards and medially. In 90 per cent of cases in adults daughter cysts are present, due to the irritation caused by the entry of bile into the cyst from the fine bile capillaries occurring in the wall. The case of hydatid cyst of the liver usually comes with a tense cystic lump in the right hypochondriac region, which is not tender unless suppuration occurs. This is caused by infection transmitted through rupture of the bile passages into the cyst, the common infective organisms, being *B. coli*, *Streptococci* and *Satyphilococci* and sometimes gas-producing organisms.

Rupture is another complication which brings the patient to the surgeon. It may occur into the peritoneum when severe anaphylaxis and later development of multiple daughter cysts occur. Such an incidence is followed by an acute abdominal trouble and proves fatal, if there is extravasation of bile. Rupture into the pleura or lungs is a complication of suppuration of a

\*Department of Surgery, Agra Medical College.

large subdiaphragmatic cyst resulting in empyema or lung abscess. Rupture of a hydatid cyst into the intestinal tract has been recorded and is also a sequel of suppuration. The parasite may ultimately die and the cyst wall may undergo calcification. The diagnosis is made by examination of a blood film and differential count which shows eosinophilia. Casoni's and complement fixation tests are confirmatory.

**Casoni's test.**—This test is done by an injection of 0.2 c.c. of filtered sterile hydatid fluid of sheep intracutaneously. A positive reaction is an erythematous eruption and a central wheal with pseudopods which appear within 20 to 30 minutes. The reaction may be delayed for 6 to 12 hours. A positive result of an immediate reaction is recorded when the lesion is at least 23 m.m. in diameter, doubtful when 20 to 23 m.m. in diameter and negative when less than 20 m.m. in diameter. Delayed reaction is not positive unless the area of reaction is at least 40 m.m. in diameter. An injection of 0.2 c.c. of normal saline is also given close to the injection of the antigen for control. A false positive reaction may be obtained in asthma, hay fever, angioneurotic oedema, urticaria and certain helminthic infections. This test may remain positive after the cysts have been opened and cleared, and thus recurrences cannot be detected. The complement fixation test does not possess this disadvantage.

### CASE REPORT

A.M., aged 20, Mohammedan male was admitted with the complaint of swelling and heaviness in the right side of the abdomen. Duration one year.

**Previous history.**—During childhood a swelling appeared in the right hypochondriac region which subsided after treatment in 3 months. He was fond of dogs and he had been associated with them intimately, as there were about 4 pet dogs in his family.

**Present history.**—For the last one year he was having heaviness and swelling in the right side of his abdomen which was gradually increasing in size. There was no bowel or urinary trouble. He got temperature occasionally. The patient was a young man of medium build and active habits. Due to the size of the swelling and heaviness he

was incapacitated to a great extent. There was no anaemia or jaundice or any glandular enlargement.

Blood pressure—120 systolic.

" — 80 diastolic.

Pulse—90 per minute.

Temperature—89.4°.

**Local examination of abdomen:** There was a swelling in the right side of abdomen extending from the right costal margin to the pelvis and across the middle line.

The swelling was cystic and smooth on the surface. It did not move on respiration. It extended up to the right lumbar region and had a well defined outline on the inner side.

The swelling was dull and the dullness was continuous with that of the liver. There was no bowel resonance behind the cystic swelling. Fluid thrill was well marked but there was no shifting dullness. Other systems were normal.

### INVESTIGATIONS

1. **Plain X-Ray of Abdomen:**—Striated appearance on the right side of abdomen. (Fig. 1.)

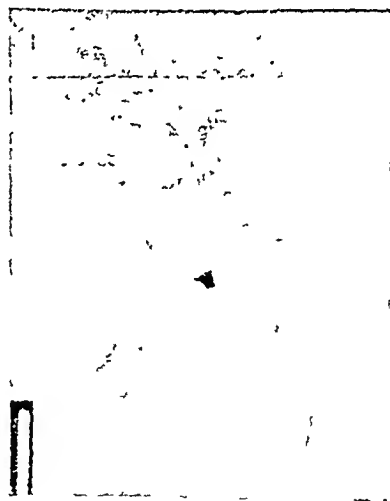


Fig. 1.

Plane X-Ray of abdomen. The cyst on the right side presented a striated appearance.

2. **Barium Enema:**—Whole of the ascending colon and caecum was seen to be pushed to the left side. (Fig. 2.)

3. **Intravenous Pyelography:**—Right kidney was displaced upward and showed evidence of secondary hydronephrosis. Excretion from both kidneys was normal. (Fig. 3.)

4. Blood examination :—Total W.B.C. 8000.

Differential count :—Polymorph 78%  
Lymphocyte 22%  
Large Mono 0%  
Eosinophiles 0%

### OPERATION NOTES

The patient was operated on under local anaesthesia and a transverse incision 4" long was made midway between the right costal margin and crest of the ilium. After the divi-



Fig. 2.

Barium Enema showing displacement of caecum and ascending colon medially.

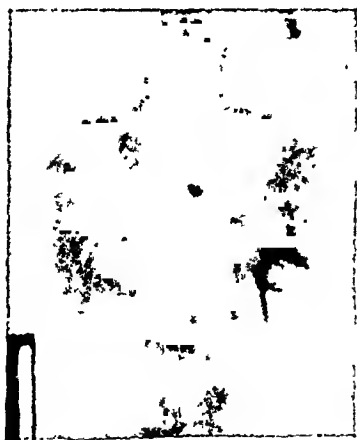


Fig. 3.

Pyelography showing hydronephrosis and displacement upwards of right kidney.

sion of the muscles the cyst was aspirated and a yellow turbid fluid was withdrawn as only some

of the cysts contained bile. Sometimes the walls of the cysts used to block the needle point thus preventing withdrawal of any fluid. An incision was made in the wall of the mother cyst and about a bucketful of daughter cysts varying from the size of a small pearl to that of a tennis ball was evacuated. The wound margins were covered with gauze soaked in formalin lotion which was also injected inside the main cyst. The latter extended from below the right diaphragm up to the bottom of the pelvis and on the inner side across the middle line. The inside of the cyst was swabbed with gauze dipped in formalin lotion. Some of the daughter cysts had to be scooped out by the fingers introduced into the right lobe of the liver. The main cavity of the mother cyst collapsed on the evacuation of all its contents and was drained by a small drainage tube. The opening in the cyst wall was sutured continuously, and the muscles by uninterrupted sutures. Irrigation by weak formalin lotion was done daily for 2 days, through the drainage tube which was removed on the 4th day. The patient was given 300 c.c. of blood and 500 thousand units of penicillin. The wound healed by primary intention and he was discharged cured on the 13th day. He reported after a month and there was no sign of any recurrence. He has been asked to take his abdominal girth regularly and to report every now and then.

### DISCUSSION

The peculiarity of this case is that the cyst was situated in the right side of the abdominal cavity, simulating a large hydronephrosis. The right kidney was hydronephrotic but it was secondary to pressure of the cyst on the right ureter. The kidney was also displaced upwards by the cyst. The plain X-Ray of the cyst was very characteristic as presenting a striated rippled appearance due to the presence of innumerable daughter cysts which are liable to throw such shadows. The barium enema is very interesting in this case, showing the inward displacement of the ascending colon, caecum and small bowels. Exploration left no doubt about the diagnosis and it was interesting to note that some of the cysts contained bile and the rest did not. Presence of thick yellow bile left no doubt as regards the origin of the cysts from the liver. The whole right lobe of the liver was evacuated. As to how the extension occurred into the abdominal cavity is a matter of conjecture. Either the cyst ruptured into the peritoneal

cavity which then got walled off or the right retroperitoneal space of the abdomen was invaded from the site of bare area of the liver as has been described. The former explanation is less probable as there was no history of acute abdomen with anaphylaxis pointing to the rupture of the cyst into the peritoneal cavity which is usually a fatal occurrence, more so when bile is present.

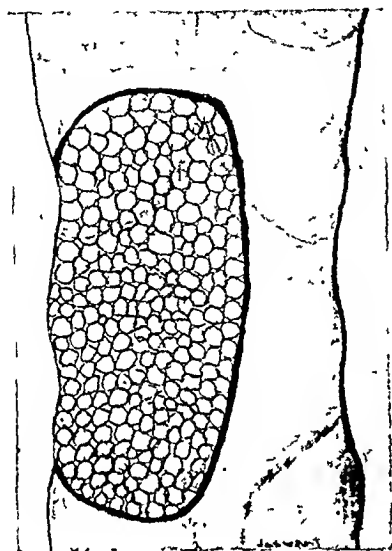


Fig. 4.

Hydatid cyst extending from below the diaphragm up to the pelvis.

Most probably the retroperitoneal tissues were invaded by rupture of the cyst in the bare area of the liver, thus enlarging itself retroperitoneally to such an extent as to invade the pelvis and displace the ascending colon across the middle line. The

operative treatment has been successful so far and it is to be seen if recurrence does not occur. Another interesting feature of the case was the absence of eosinophilia which is usually present.

### Summary

1. The literature on hydatid infection of the liver has been reviewed.
2. A case of hydatid cyst of the liver with extension into the abdominal cavity has been described.

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## REVIEWS OF BOOKS

**Clinical Methods in Surgery**, K. Das, City Book Company, 15, Bankim Chatterjee Street, Calcutta, 1947.

This book is a practical guide to the student of surgery in the systematic investigation of clinical cases and fills a long-felt want. After giving a general scheme of case taking, the book goes on to the detailed examination of special regions and special methods of examination of different conditions. The approach is essentially a practical one and the student is instructed as to what is to be done on the examination of a particular condition and how it is to be done. The book is profusely

illustrated and the illustrations are well reproduced and aptly chosen. The paper, printing and general get up leave nothing to be desired.

The book will be found to be invaluable by the undergraduate student, who will find, within its 240 pages, practically all that he needs to know in the clinical examination of surgical cases. The book is priced moderately at Rs. 20/- and we are sure that any student who gets a copy of this book will find his twenty rupees well invested.

C. P. V. M.

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1. *Treatment of Elephantiasis and Lymph Oedema—*

Opener : Dr. V. P. Mehta, Bombay.

Seconder : Dr. T. Kanakaraju,  
Ramachandrapuram.

2. *Treatment of Hernia with Fascial Grafts and Silk Sutures—*

Opener : Dr. P. Chatterjee, Calcutta.

Seconder : Dr. S. K. Datta, Calcutta

3. *Treatment of the Bone Cavities in Chronic Osteomyelitis—*

Opener : Major D. K. Sabhesan, Madras.

Seconder : Dr. B. N. Sinha, Lucknow.

#### 12th Meeting :

1. (a) *Bronchiectasis—*

Dr. R. Mahadevan, Madras.

- (b) *Lung Abscess—*

Dr. S. J. Mehta, Bombay.

2. *Intestinal Obstruction in Children—*

Opener : Dr. A. E. DeSa', Bombay.

Seconder : Dr. R. A. Irani, Bombay.

3. *Sciatic Syndrome—*

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# THE INDIAN JOURNAL OF SURGERY

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MARCH 1949

No. 1

## DYSGERMINOMA OF THE OVARY

by G. D. VELIATH and G. S. VISWANATHAN, Madras.

### Introduction

The primary neoplasms of the ovary constitute an interesting and difficult study. Very often the cellular elements that make up a number of these tumours differ so fundamentally from the tissues of the normal ovary that one is forced to find an explanation regarding their derivation and their presence in the area of the ovary. One way of accounting for these tumours of cell types so foreign to the normal structure of the ovary was to label them as teratomas showing a predominantly one sided development of misplaced embryonal germ cells. This process of explanation, however, did not bring the necessary light in our understanding of ovarian neoplasms. Thanks to the work of Meyer, Schiller, Fischel, Barzilai and others, we can claim at present a better knowledge of these tumours and their relationship to the early developmental stages of the ovary. This paper deals with five cases of dysgerminoma of the ovary received for examination in the Department of Pathology, Stanley Medical College, Madras, during the period 1942-'48.

The term 'dysgerminoma' is of recent origin (Meyer 1931). These neoplasms used to be known as embryonal carcinoma or seminoma of the ovary. Though looked upon as a rare tumour they have recently attracted much attention and reports of cases are becoming more frequent especially in American and European literature. Sufficient attention has not been focussed on these tumours in Indian Medical literature. Seven cases were described by Menon and Veliath from the Pathology Department of the

Andhra Medical College, Vizagapatam in a study of thirteen uncommon tumours of the ovary from a series of 204 ovarian neoplasms. These growths are of considerable interest because of their predilection in children and young adults, their potential malignancy, the differing views of their origin and their close similarity in cell type and tissue pattern to the seminoma of the testes.

### REPORT OF CASES

Case No 1. L, a girl of 13 years was admitted to the Stanley Hospital on 1-5-48 for a growing abdominal tumour in the left lumbar region of 7 months duration. Operation (Dr. K. Chintan Nambiar—24-5-48) showed a solid freely moveable growth of the left ovary. Abdominal cavity contained several ounces of serous fluid. The tumour measured  $21 \times 14 \times 10$  cms. and weighed 1384 grams. It was encapsulated and elastic, the outer surface was smooth and slightly nodular while the cut surface showed a homogenous yellowish white substance with fibrous bands coursing through it presenting a lobulated appearance. There were no areas of hæmorrhage or degeneration. Section showed a more or less uniform appearance of groups of spheroidal cells separated by a fibrous stroma. The cell boundaries were indistinct and the cytoplasm translucent and faintly eosinophilic. Nuclei were large and round. Mitotic figures were numerous. Stroma showed lymphocytic infiltration (Fig. No. 6).

Diagnosis: Dysgerminoma of the ovary.

Case No 2. K, a woman of 25 years was admitted to the gynec wards of the R.S.R.M. Lying-in-Hospital, Madras, on 13-11-43 for a growing pelvic tumour of one year's duration. She was married 7 years ago, had one child which died one month after birth. Operation (Dr. A. P. Kuriappan—20-11-43) revealed a large solid tumour arising from the right ovary which had undergone a twist on its pedicle. A number of secondary nodular growths of varying sizes were found over the omentum and peritoneal surface of the pelvis and abdomen (Fig. No. 5). The growth was removed along with the larger secondaries. Patient was

\*From the Dept of Pathology, Stanley Medical College.

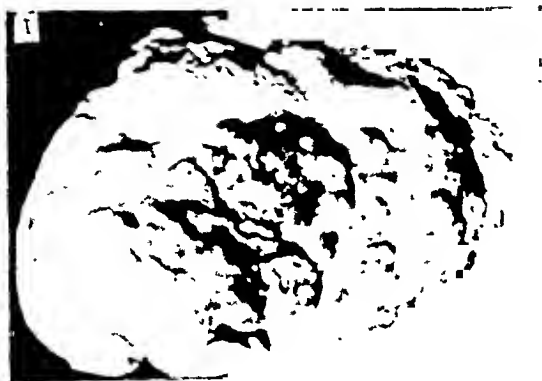


Fig. 1.

The gross nodular outer surface in case No. 2.



Fig. 2.

The homogenous cut surface with areas of haemorrhage and degeneration in case No. 2.

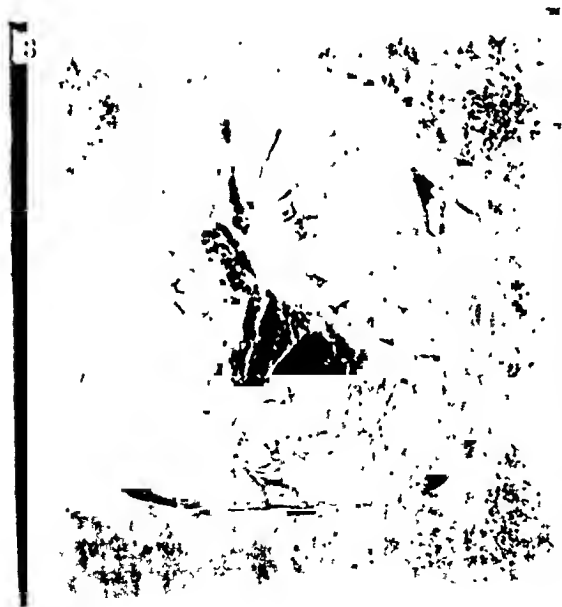


Fig. 3.

The smooth outer surface in case No. 3.

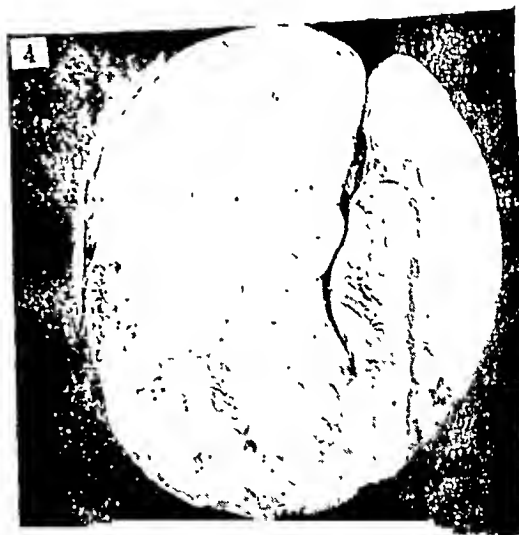


Fig. 4.

The uniform cut surface in case No. 3.



Fig. 5.

Nodular secondary growths over the omentum in case No 2

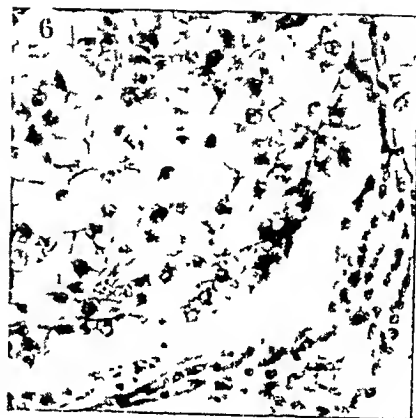


Fig. 6.

Photomicrograph (H & E X 220) of case No 1. showing groups of translucent spheroidal cells with lymphocytic infiltration of the stroma.

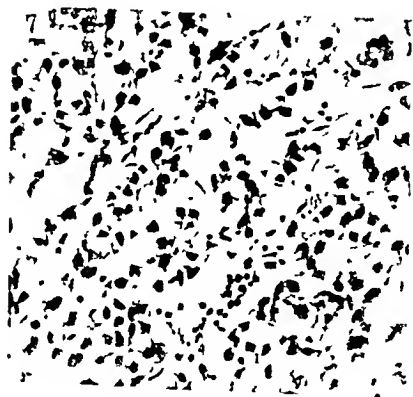


Fig 7.

Photomicrograph (H & E X 220) of case No 2 showing clear spheroidal cells arranged in cords with a few lymphocytes in between.

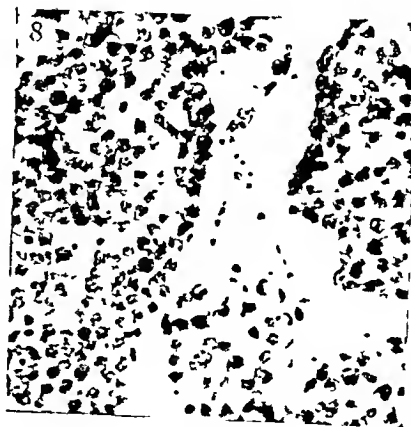


Fig 8

Photomicrograph (H & E X 220) of case No 3 showing irregular groups of translucent spheroidal cells separated by a loose fibrous stroma containing a few lymphocytes.

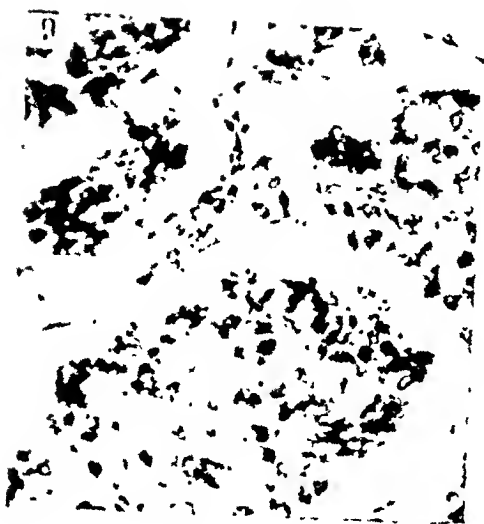


Fig. 9.

Photomicrograph (H & E. X 220) of case No. 4, showing large alveoli of clear spheroidal cells surrounded by loose fibrous stroma.

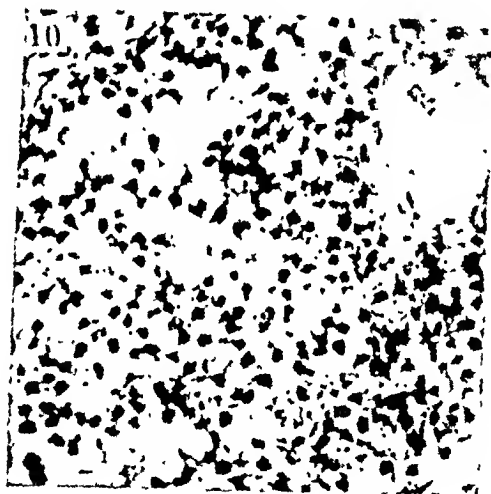


Fig. 10.

Photomicrograph (H & E. X 220) of case No. 5, showing sheets of clear spheroidal cells.

later given a course of deep x-ray therapy (17 exposures); was discharged on 1-1-44. Patient was seen again three months later; her general condition had improved and there was no evidence of any secondaries anywhere. The growth measured 22 x 19 x 17 cm. and weighed 3503 grams. The outer surface was nodular (Fig. No. 1) while the cut surface was elastic, homogeneous, greyish white in colour with areas of haemorrhage and degeneration (Fig. No. 2). Microscopic appearance showed clear spheroidal cells with large vesicular

nuclei arranged in groups and cords (Fig. No. 7). Areas of haemorrhage and degeneration were present. Mitotic figures were numerous; a few symplasmic giant cells were seen around the degenerated areas.

Diagnosis: Dysgerminoma of the ovary.

Case No. 3. M, a young woman of 18 years, was admitted to the R.S.R.M. Lying-in Hospital, Madras, on 18-8-48 for a large hard immovable swelling occupying practically the whole of the abdominal cavity, of six months duration. Operation (Dr. P. Madhavan—24-8-48) showed that the growth was associated with the right ovary. The tumour measured 20 x 17 x 15 cm. and weighed 2596 grams; was capsulated with a smooth outer surface (Fig. No. 3) and a pinkish white homogeneous cut surface (Fig. No. 4). Microscopic appearance was characteristic with irregular groups of translucent spheroidal cells with many mitotic figures, separated by thin fibrous stroma permeated with lymphocytes (Fig. No. 8).

Diagnosis: Dysgerminoma of the ovary.

Case No. 4. G. G., a young woman of 18 years was admitted to the Head Quarters Hospital, Cocanada for a gradually growing abdominal growth of one year's duration. Operation showed a large solid growth of the left ovary 26 cm. in length and 23 cm. in diameter. Part of the growth was received in the Pathology Department of the Stanley Medical College on 26-5-44. The portion received showed a smooth lobulated outer surface while the cut surface had a uniform greyish white appearance. Microscopic appearance showed large alveoli of clear spheroidal cells with numerous mitosis surrounded by a stroma infiltrated with lymphocytes which in some places were collected in small groups (Fig. No. 9).

Diagnosis: Dysgerminoma of the ovary.

Case No. 5. B., a female child of 10 years was admitted to the Head Quarters Hospital, Cocanada for distension of the abdomen and difficulty in passing urine. Operation showed a solid growth of the right ovary filling up the whole of the pelvis and occupying the abdominal cavity upto the level of the umbilicus. The omentum large intestine and appendix were adherent to the growth. There was blood-stained fluid present in the abdominal cavity. Portion of the tumour was received in the Pathology Department of the Stanley Medical College on 18-1-43. The portion received showed a more or less smooth outer surface while the cut surface was greyish pink in colour with areas of degeneration and haemorrhage. Section showed spheroidal cells with clear cytoplasm and vesicular nuclei arranged in sheets (Fig. No. 10) separated by fibrous septa of varying width. Many mitotic figures were present. Lymphocytic infiltration of the stroma was not prominent.

Diagnosis: Dysgerminoma of the ovary.

## Discussion

An intelligent understanding of the origin and behaviour of this tumour is possible only with some acquaintance with the normal embryology of the ovary. In the early embryonal development the sex gland either male or female is represented by groups of mesenchymal cells collected on either side of the attachment of the dorsal mesentery and covered over by the coelomic epithelium. At this rudimentary stage, the cells comprising the gonad show no developmental potency along either male or female lines. This is the dysgerminal phase of gonadal development. The primordial germ cells make their way into this area and their advent most likely gives the stimulus to differentiation and later on the germ cells or oogonia become surrounded by clusters of specialized granulosa cells. The gland is now definitely ovarian in character and make up. It is, however, conceivable during gonadal development of both male and female, certain cells of the early undifferentiated stage may lag behind and fail to keep pace with the developmental progress of the main mass. These rests of dysgerminal cells may in later life give rise to tumours. As the cells of origin date back to a stage when they have not become tinged with male or female characteristics, these tumours exhibit no capacity to modify sex characters. This is the prevailing view of the origin of the dysgerminoma. The idea is summed up aptly in Barzilai's definition which is as follows; "The dysgerminoma of the ovary is a germinal tissue tumour made up of cellular elements indistinguishable from the sexually undifferentiated mesenchymal cells of the early gonad." The presence in the testes of a tumour of almost identical cell structure lends much support to this view, for the possibility of dysgerminal cell rests occurs as much in the gonad which later develops into the testes as in that which develops into the ovary. Further support to this idea of origin is found in the high incidence of these growths in hermaphroditic gonads which probably develop a dysgerminal or neutral zone between the

zones of different sexes. Though this hypothesis is satisfying and generally accepted there are certain cases reported where dysgerminoma is associated with teratoma suggesting that the cell of origin is totipotent and belongs to the sex cell series.

The age distribution of our five cases is significant—10, 13, 18, 18 and 25 with an average age of 16.8. In the seven cases reported by Menon & Veliath, the average age was 17, while in Novak's series of 17 cases, the average was 20. This predominance in children before puberty and in young adults has earned for it the appellation 'Carcinoma puellarum.' In this characteristic, however, it differs from its homologue the seminoma of the testes which is rather uncommon before the age of 30. Another trait given much prominence by Meyer is its frequent association with hermaphroditism, hypogonitalism and amenorrhoea. None of our cases gave any evidence of hermaphroditism; one gave a history of amenorrhoea of two years duration prior to admission. The reported frequency in the right ovary is present, though not significant, in our series, where the tumour was found in the right side in three out of five cases. The presence of ascites in two of our cases is noteworthy. This effect is produced by a number of ovarian neoplasms. Occasionally there is an associated hydrothorax thus completing the picture of Meig's syndrome. It is presumed that the ascites is caused by a weeping oedema effected through partial obstruction of the venous return.

Macroscopically they are solid growths sometimes attaining to great size—Case No. 2 weighed 3503 grams—capsulated, with a smooth or bossy outer surface and a doughy or rubbery consistence. Section presents a fleshy homogeneous appearance, greyish or yellowish white in colour. Areas of degeneration and haemorrhage are common especially in large growths.

The microscopic structure is characteristic permitting of a positive diagnosis in nearly all cases. The cells are large clear poly-

hedral with vesicular nuclei arranged in sheets or large alveoli surrounded by a fibrous stroma infiltrated with lymphocytes. Occasionally the cellular arrangements resemble columns or cords. Mitotic figures are present and usually conspicuous. The intensity of lymphocytic infiltration of the fibrous tissue stroma varies, and some cases show giant cells of the Langhans type and epithelioid cells giving a superficial resemblance to tuberculosis. The presence of these giant cells has not been satisfactorily explained. They are not related to tuberculosis. According to Dockerty, the giant cells like the lymphocytes and epithelioid cells represent a chronic inflammatory reaction to the presence of lipid deposits derived from the degenerating tumour cells.

Dysgerminoma is definitely malignant, but the degree of malignancy varies. It shows a remarkable rapidity of growth and infiltration of the capsule sooner or later, while a number of cases showing secondary deposits have been reported. One of our cases—case No. 2—showed large nodular secondary growths over the omentum and peritoneal surface of the pelvis and abdomen. It must be mentioned however, that the degree of malignancy cannot be judged by a study of microscopic appearance alone for histologically all dysgerminomas display malignant characteristics and there appears to be no constant relation between the cellular picture and the grade of malignancy. Every one of our five cases showed microscopic evidence of rapidity of growth with numerous mitosis though they varied widely in clinical behaviour. Histological malignancy cannot, therefore, be taken as criterion for prognosis. There is an impression that unilateral tumours are generally benign but our observations do not support it.

The treatment of dysgerminoma has generally been surgical. With early and encapsulated tumours it is better to remove only the involved ovary and keep the patient under frequent observation and any possible

recurrence of the neoplasm when found should be treated by irradiation. Cases showing evidence of local extension should be subjected to a more radical surgical procedure and followed by deep Roentgen ray therapy. For inoperable cases thorough irradiation is definitely indicated. There are many reports of rapid regression under irradiation. In our small series the response shown by case No. 2 was remarkable.

### Summary

Five cases of dysgerminoma of the ovary are reported, one of them showing extensive secondary deposits over the omentum and peritoneal surface of the pelvis and abdomen.

The origin and general characteristics of dysgerminoma are discussed.

### ACKNOWLEDGEMENT

Cases 1, 2 and 3 were received from Drs. K. Chintan Nambiar, A. P. Kuriappan, and P. Madhavan; while cases 4 and 5 were received from the Superintendents of the Head Quarters Hospital, Cocanada. We gratefully acknowledge our indebtedness to these doctors.

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## TALIPES EQUINOVARUS\*

by R. KALAMEGHAM, *Trichinopoly.*

The subject of Talipes Equinovarus is a very big and specialised one. The purpose of this paper is to lay emphasis on the good results of conservative treatment of congenital club-foot. It is my experience that most of these feet can be successfully corrected by manipulation and plaster casing with an occasional operative procedure like tenotomy and/or, a fasciotomy. My remarks are based on an experience of about 200 cases made up partly of those that came to the Government General Hospital at Madras when I was there, partly of cases that came under my care in the local Civil Hospital at Trichinopoly while I was an honorary member of the staff, but mostly of cases in my private work.

Regarding the *etiology* of the condition, I have very little to add to the existing theories of causation except to say that none of these theories explain the facts in every case and that we are still far from an understanding of the actual causative factors. The following theories have been advocated :—

- (1) Faulty implantation of the ovum as in endometritis and tubal pregnancy
- (2) Purely mechanical process. This is the commonly accepted theory dating from the times of Hippocrates.
  - (a) Normally the foetus keeps the legs in a folded position. In this position of the leg if extra pressure is brought about and maintained, the outer border of the foot receives the major portion of the pressure and gets into a position of forefoot adduction. With further degrees of pressure the whole foot swings into the varus position and owing to the inclination of the joint surfaces equinus also results. In some cases there need not be an equinus, but the toe is forced upwards. The objection to this theory

is that there cannot be such a constant pressure as this in the gravid uterus owing to the presence of amniotic fluid and owing to the fact that the foetus moves about and hence the feet could not be held always in a position of acute flexion. (b) Abnormal position produced as in cases of deficient amniotic fluid, fibroids, interlocking feet and entanglement of umbilical cord.

- (3) Theory of hereditary defect. Brockman is an advocate of this theory. He believes that there is a dislocation of the head of the talus out of the socket formed for it jointly by the navicular, the sustentaculum tali and the spring ligament. There is, according to him, an aplasia of the socket owing to the non-separation of the navicular from the sustentaculum tali.

In my series of cases the sex distribution of the condition is about equal and bilateral cases are just a little less frequent than unilateral ones. I had only three cases out of my total where other congenital anomalies existed along with the condition. Heredity was traceable in 23. There was no special preponderance in the first born of the family.

**Clinical features :** In unilateral cases the deformity may not be very severe, but the affected foot is smaller than the other. A prominence formed by the talus on the dorsum of the foot is present. The lateral border of the foot is concave and the medial is convex. The fore-foot is plantar flexed upon the hind foot. The heel is rotated medially and upwards. In more severe cases a genu valgum is present, which is not evident in the earlier months of life but shows itself when the baby stands up and starts walking. The gait is a stumbling one. Bursae and callosities may develop over the weight-bearing areas.

\*A paper read at the Tenth Annual Conference of the Association of Surgeons of India, Dec. '48.



In the earlier months the condition is mostly a soft tissue deformity and, according to Browne, three distinct degrees of error may be distinguished. In the first adduction of the fore-foot may be the only error. In the second degree inversion and equinus are found. In the third or extreme degree the toe is pointing upwards. The lateral malleolus is prominent while the medial is flattened and poorly developed.

**Tendons and Muscles :** Muscles are poorly developed and tendons delicate. The tendo-calcaneus travels downwards and inwards to its insertion and becomes an active inverter of the foot. The plantar muscles of the medial side are tensely contracted. The anterior muscles of the leg are elongated.

The ligaments on the medial side and those of the talo-calcaneo-navicular joints are contracted. The deltoid ligament and the plantar calcaneo-navicular ligament are also shortened.

**Bones :** Bony changes are found in long standing cases. The talus, the calcaneus and the cuboid get altered in that order.

**The talus :** A large portion of the articular surface is out of the tibiofibular mortice and becomes prominent on the dorsum of the foot. This part gets broadened and is an obstacle to dorsiflexion in extreme cases. The head and the neck of the talus get deflected medially and downwards carrying the navicular and the forefoot with them.

**The calcaneus :** The calcaneus gets an inward twist so that the medial tuberosity approaches the medial malleolus. The anterior portion of the bone is deflected medially under the neck of the talus.

The navicular and the cuboid are displaced inwards.

The phalanges and metatarsals are flexed and splayed out fanwise.

All these deformities are well brought out in the radiographs (Fig. 1-a & 1-b) where a normal foot and an abnormal one in the same patient are shown.

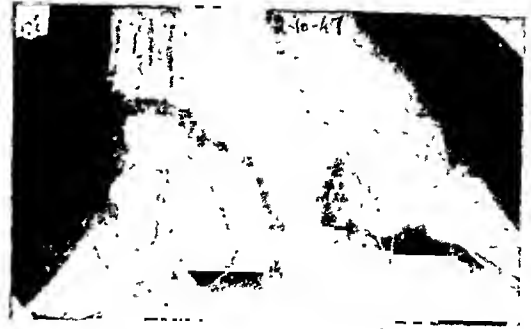


Fig. 1-a.



Fig. 1-b.

All these individual displacements of the bones can be collectively classified into three deformities. They are

- (1) Adduction
- (2) Inversion
- (3) Equinus.

Apart from these, there is a fourth factor—the internal rotation of the shaft of the tibia and presumably the rotation of the fibula also. All these deformities are not of the clear-cut water-tight type but are inter-related, merging one into the other to give a total deformity denominated *talepes equinovarus*.

Adduction is a fore-foot one and may be considered as an angulation at the midtarsal joint. It may also be called a fore-foot varus.

The inversion is of the entire foot. There are two components to this inversion—fore-foot and calcaneal.

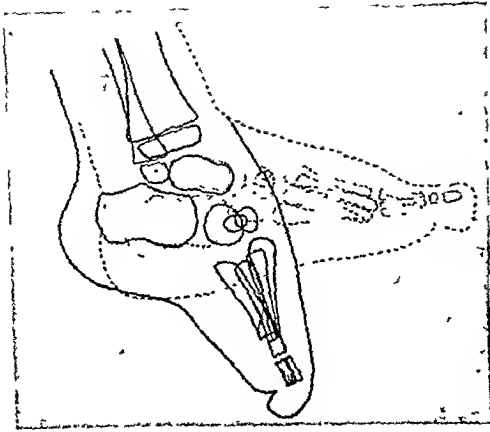


Fig. 2.

The equinus has again two components—fore-foot and ankle—both of which may be present together or remain only as a pure angle equinus. If there is a pure fore-foot equinus the case is one of pes cavus.

The fore-foot components of the three main deformities are collectively called and described as "varus". This is well illustrated in the diagram after Hauser (modified) (Fig. 2).

1. Adduction.
  - Forefoot Adduction or
  - Forefoot Varus
2. Inversion.
  - (a) Calcaneal
  - (b) Forefoot
3. Equinus.
  - (a) Forefoot
  - (b) Ankle

**Radiological Anatomy (Fig. 3).** Routine pictures of the feet in the a.p. and lateral positions are taken in as standard a position as possible. X-ray pictures of the foot taken during the earlier months of life do not show the navicular, cuboids and cuneiforms. The cuboid appears first in about 4 months of life, the navicular appears any time between 1½ to 4 years while the cuneiforms take from 3 years to 7 years to appear. The



Fig. 3.

a.p. view shows the positions of the calcaneus and astragalus. The calcaneus is placed directly under the astragalus with their axes almost in the same plane; while normally the talus is shifted to a more medial position with its long axis pointing to the first and second toes and the calcaneus is rotated outwards the long axis of which points towards the fourth and fifth metatarsals. Restoration of this normal position is to be aimed at in every case treated for the correction of the deformity. In the same view the forefoot inversion, the position of the navicular and the splaying of the metatarsals together with the phalanges are also shown.

In the lateral view the astragalus is on a more anterior plane than the tibio-fibular mortice and is placed in a more forward position than the calcaneus. In a normal radiogram in this view a line dropped from the anterior surface of talus downwards perpendicular to the foot must be just a little forward from the anterior edge of the

calcaneus or almost in line with it. In a talipes case the line is very far forward from the calcaneus. Again, in a normal case the astragalus is directly under the tibio-fibular mortice.

**Diagnosis:** A mild degree of inversion of the foot is normally present in the baby, and this must not be mistaken for talipes. Deformities due to spina bifida and poliomyelitis must not be mistaken for this condition.

**Prognosis:** With early effective and continued treatment with a good follow up all cases should be cured with manipulation and plaster casings and a useful and properly shaped foot can be obtained. In older children the condition should be greatly improved perhaps with the addition of a few minor operative procedures like tenotomy and fasciotomy.

**Treatment:** The objects of treatment are two in number according to Jones. (1) The deformity must be reversed—(I would say corrected). (2) The muscular power of the limb must be developed to a sufficient degree to maintain correction.

The correction of the deformity should be in the following order:—

- (1) Fore-foot varus
- (2) Calcaneal inversion
- (3) Equinus
- (4) Tibial rotation.
- (5) Genu-valgum.

**Fore-foot varus.** This fore-foot varus deformity which, according to my view, is a combination of fore-foot adduction and inversion is the one that should get first priority in the manipulative treatment of talipes equinovarus. An improper correction of this deformity is the one great cause for recurrence of the condition later on. Many orthopaedists have individual ways of approach to this problem. It is in this aspect that I have a contribution to make and my fond hope is that with this method there will be very few recurrences; and if it recurs at all, it must be because of a bad

follow up and by improper and inadequate retention of the correction that has been attained. In manipulating this varus deformity which must get first priority, the position of the navicular must be kept in mind. The association of the inversion and equinus components in the fore-foot displaces the navicular medial to the head of the talus and thus the talus becomes prominent on the dorsum of the foot. This medial shift of the navicular is the most important one to be corrected to get good results. The correction of this navicular shift alters the relative abnormal position of the talus and aids in correcting the fore-foot equinus also. This correction of the navicular shift is again the key to avoid a 'rocker bottom' result of the fore-foot which is often seen in poorly corrected cases and according to my lights in those cases treated by Dennis Browne's method. Roentgenographically this correction is verified by the attainment of the relative normal position of the astragalus and the navicular and the calcaneus. A typical



Fig. 4.

'rocker bottom' radiograph is shown (Fig. 4). If it is present in cases after manipulation the deformity is certain to recur. The forefoot deformity should be corrected so that it points 20 degrees outwards from the sagittal plane.

The calcaneal inversion is corrected next, the ankle equinus and the tibial rotation may also be attended to at the same time. Clinically the calcaneal inversion can be gauged by noting the direction of the tendo-achilles. Whilst, in the normal, it is either

perpendicular to the heel or tilted a little lateralwards, in cases where calcaneal inversion is present the tendon is tilted medialwards (Fig. 5).



Fig. 5.

If the ankle equinus is forced before the varus deformity is fully corrected, the navicular does not move a millimeter from its fixed position. The talus is fixed again in the mortice and the result is a 'rocker bottom'. If the calcaneal inversion is not corrected, there is later on toeing in of the forefoot when the child walks and gradually the varus deformity recurs.

If the inward rotation of the tibia is not attended to, it leads to a toeing in or adduction of the fore-foot in turn leading to a calcaneal inversion which results in recurrence. All this is due to faulty dynamics in walking. The toeing in of the foot in a case of persistent tibial rotation leads to a broad-based gait which leads to a genu valgum later on.

About fifty of my cases were treated by the old method of manipulation to arrive at an over correction and a good number of them developed flat feet. It was after observing this that I avoided the extreme over correction of the forefoot varus. The next few cases were treated by the Denis Browne method and according to my interpretation of his paper my difficulty was in keeping the limb fixed to the plates in his splints owing to the fact that the ankle equinus was persistently strong. This was especially so in the short heel case. Another factor was the extremely hot and humid climate leading to a lot of sweating and consequent skin exco-

riations leading to difficulty in the child retaining the splints. Again a good number of my cases had developed a 'rocker bottom' with consequent relapse. Possibly Dennis Browne had a different way all his own; but I have failed in the method, perhaps due to my faulty understanding of his technique.

The next set of cases were treated in plaster casing with both legs joined together with a plaster of paris connection maintaining an external rotation of the leg to avoid the difficulties in splinting and to allow the child to kick its legs about, as in Dennis Browne's method. This too was not satisfactory as toileting was difficult and the bandage got soaked with urine. After my short experience of Dennis Browne's method I had to fall in line with the late Sir Robert Jones when he said 'the corrective power of an apparatus in club-foot is negligible; and if apparatus is to be used it is to be regarded as a means of retaining correction already obtained by other methods.'

The rest of the cases were treated by the method just to be described and a typical end result will be seen from the pictures,

When a case is registered in the office case notes consisting of the family history, any evidence of specific infection in the mother, the position of the child in the family tree, the nature of presentation during delivery, if possible, and also whether it was a natural or an instrumental delivery is recorded. Clinical examination is done to assess the nutritional state and the general condition of the child. The state of the skin of the leg is also looked into, in view of the use of adhesive plaster strapping for the first few days of treatment.

The child is given a thorough examination to find out any other congenital deformity that may be present. Then clinical photographs of the child's feet are taken and radiograms also in two views (a.p. and lateral) in as much of a standard position as possible (Fig. 6-a, b, c & d). A clinical estimate of the position of calcaneal inversion and the astragaloid prominence is noted before treatment is started.



Fig. 6-a.



Fig. 6-c.



Fig. 6-b.



Fig. 6-d.



Fig. 7-a.



Fig. 7-b.

The foot is dabbed with spirit and then a gradual manipulation is started with the child lying on its back in front of the surgeon. The surgeon taking hold of the left ankle of the child with his right hand in a strong grip to protect the joint during manipulation, with his left thumb pressing on the astragular prominence and the rest of the fingers in contact with the sole, a screw like motion is attempted everting the forefoot with a certain amount of force consistent with the resistance offered by the child's tender foot. No anaesthesia is given. Then a plaster strapping is put on as shown in the diagram (Fig. 7-a & b). The child is to report the next morning. The next day the plaster is probably loose because the adhesive slips due to the tension present in the forefoot. The strapping is removed, the leg cleaned up with spirit and the same manipulation is repeated. In a few of my latest cases I have used the method of Dr. Katrak of Bombay with a slight modification. Day after day Dr. Katrak puts a fresh strapping over the old to take up the laxity that has crept in, and if possible, get at a bit more of correction. As I believe that more can be wrought by manipulation, than by a passive stretching of the foot Dr. Katrak's method is followed by me for three or four days consecutively. Then the entire adhesive is removed, the foot is manipulated and restrapped in a fresh adhesive strip.

It has been my observation in the last series of cases that while manipulating the forefoot usually on the third or fourth day, a snapping sound is 'felt' somewhere near the base of the first metatarsal—this sound is probably a transmitted one of some ligamentous structure that has snapped. My feeling is that the snapping is somewhere in the spring ligament.

In the absence of facilities for an autopsy, it is difficult to assess the exact nature of the 'snap'. Immediately the sound is heard as though some cord-like structure has given way under the force of manipulation (I may add that the force is not too aggressive) the forefoot swings into a corrected

position with no over-correction at all and I am sure that there will be no more trouble with it except to keep it in position by plaster casings. The navicular shift is corrected thereby and the radiograph confirms this. What remains now is to keep up the correction and to switch our attention to the calcaneal inversion, equinus and tibial rotation.

The usual results of this type of a screw-like motion on the forefoot while at the same time exerting a downward pressure on the astragalar prominence is to force the astragalus down and lift the navicular up and in front of the astragalus by probably breaking the spring ligament and altering the relative positions of the navicular, the sustentaculum talus and the cuboid. What remains to be done for the corrected varus is to keep the forefoot in the corrected position,—e.g., in  $20^\circ$  of external rotation of the foot to the sagittal plane of the foot and slight eversion, and not too much of over-correction—in a plaster-casing. In my older series of cases my difficulty was in holding the foot in the corrected position while the plaster casing was being applied especially so when a hefty baby struggles hard and non-cooperates. Later on I found that just before this by strapping the foot of the child in an adhesive strap as shown in the figure, (Fig. 8) it enables the assistant to hold the foot even against a struggling child. There is another advantage in this strapping to be



Fig. 8.

explained later. The plaster cast is applied over the adhesive, the cast extending from just below the knee down to the toe tips. While it is setting the surgeon gently manipulates the forefoot into a mild everted position, the ankle is dorsiflexed to correct the equinus by stretching the tendo-achilles, the whole foot is rotated outwards to about  $20^\circ$  from the long axis of the leg to exert a twisting force on the tibia to correct gradually the inward rotation of the bone and finally the heel is tilted lateralwards to correct the calcaneal inversion. All these four manoeuvres are done quickly while the plaster is setting and the assistant gently moulds the plaster round the ankle (Fig. 9). It is here that the plaster strapping that was applied previously plays its second role. While the gypsum is moulded to suit the contour of the foot and ankle the adhesive protects the lateral malleolus from pressure points.

The child is asked to report the same evening to look up for any pressure symptoms and if nothing is present it is asked to report after a week or ten days. Next time the casing is removed, the child is left free

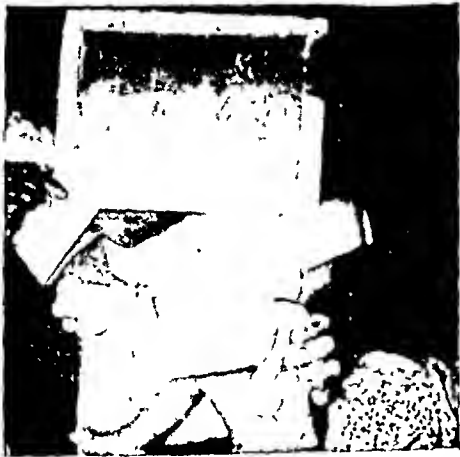


Fig. 9.

for a day and gets a second casing done on the same lines as described previously and asked to report ten to fifteen days later. This goes on till the child is able to stand up at least with the help of a support while in the meantime check up x-rays of the feet

are taken to keep an eye on the bones of the foot. The frequency of plaster casing applications gets longer as days pass and as the infant's foot grows, and then a stage is reached where the child can be measured for a boot. A pair of boots of an ordinary



Fig. 10.

type is prescribed with instructions that the left foot boot be worn on the right and vice versa (Fig. 10).

At home the mother is asked to carry out the eversion of the forefoot with the boots on. As the child starts moving about with aids, the *internal* aspect of the boot is raised about  $\frac{1}{4}$ th of an inch and the child is allowed to walk with the usual right foot boot on the left. This exchange of boots according to Blumenfeld gives a toeing out of the feet which he calls the 'Charlie Chaplin Position' and also everts the whole foot.

Henceforward the visits of the child to the office become scarce but yet follow up is carried on. On the faintest suspicion of a relapse of the deformity x-rays are taken, manipulation and immobilisation are carried out on the relapsing forefoot deformity to restore normal dynamics of the foot. The deformity may be considered as cured when there is no abduction or inversion deformity when there is a hollow on the dorsum of the foot in the position previously occupied by the head of the talus, and when the child is able to evert and dorsiflex the foot voluntarily to about a right angle and above all radiology shows normal findings in the dispositions of the bones of the foot.

While in the earlier cases I was using the Thomas' wrench, I have not touched this

instrument for talipes cases of late and have depended on the force my thumb, fingers and wrists were capable of. My opinion is that the wrench is not precise in its work, does not replace the fine touch of one's own fingers and that it is clumsy in its use. It may be a valuable instrument in dis-impacting a Colles' fracture; but it is, of no use, in my opinion, in talipes in the tiny delicate and tender foot of an infant.

Occasionally I use the padded wedge to force down a prominent astragalus when it is too hard for my fingers. In this procedure one does not lose the sense of touch or the estimate of the force required.

In a few cases where a short heel with a contracted achilles tendon presents itself after the forefoot varus is corrected, a lengthening of the tendo achilles is done to correct the equinus deformity. I do an occasional achilles tenotomy in a few cases of refractive calcaneal inversion also. The tenotomy is of the 'z' type with the tendon lengthening by the open method. The medial side of the tendon near the calcaneus is cut so that after the operation is done the finished tendon has an action of pulling on the lateral aspect of the posterior surface of the calcaneus. Thus exerting a slow corrective force for the calcaneal inversion.

#### CAUSES OF RECURRENCE

1. The prime cause is bad correction of the deformity especially the varus.

2. The next cause is not keeping the corrected foot in the proper position for a sufficiently long time.

3. Heavy manipulations concentrated on the forefoot deformity and over-twisting of the forefoot during manipulations without correcting the navicular shift, leads to a flaring of the fore part of the foot. I have had cases where the attention has been mainly concentrated on the fanning of the metatarsals. The inward bending of the fanned out metatarsals have been twisted out (everted). The subastragaloids and the talus have not been touched at all. I can

quote one case of mine treated similarly and the feet could not be restored to a normal physiology by fasciotomy and achilles tenotomy. Secondly, if the relative positions of the calcaneus, the talus, the navicular and the cuboid have not been restored after manipulation, as verified by x-rays of feet compared with the normal radiological anatomy I am sure recurrence is bound to come sooner or later.

Thirdly if the calcaneal inversion is not corrected one should expect some time or other a recurrence of the deformity owing to faulty dynamics in walking.

Lastly the inward rotation of the tibia has to be corrected also. If not, here also a toeing in of the forefoot takes place which later on leads to a varus deformity.

It is not often difficult to determine the presence of the lateral rotation of the tibia in a good percentage of cases before the equinovarus is corrected. When once this is corrected and the child is walking we find in those cases of persisting tibial rotation a toeing in of the foot without the forefoot adduction. A line drawn from the anterior superior spine of the ilium bisecting the patella will fall to the lateral border of the foot outside the little toe instead of between the great and the second toes as in a normal case. With the patella pointing straight forward palpation of the malleoli at the ankle will show the external malleolus to be in a more anterior plane than the medial malleolus instead of being on the same plane as in the normal. Thus when the child is walking the weight bearing thrust falls obliquely along the long axis of the foot and drives the scaphoid around the medial side of the head of the talus with recreation of the adduction deformity of the forefoot. If this same force is allowed to continue later on varus of the heel and then inversion of the foot will follow the adduction and the original deformity recurs. These undesirable sequelae to correction of club foot can be obviated if even during the process of manipulation an external twist is given to the shaft of the tibia which succeeds in many



cases. If these manoeuvres fail a rotation osteotomy of the tibia may have to be done.

In conclusion let me state that cases of congenital talipes equinovarus are amenable to conservative manipulative treatment, if they are brought in before the child starts walking and preferably very early in life.

The key to successful manipulation lies in correcting the astragalar prominence and the navicular shift and restoring the normal radiological anatomy of the calcaneus, the astragalus, the navicular and the cuboid.

By the method suggested a snapping sound is heard somewhere about the spring ligament during manipulation and after this the varus deformity is corrected.

If my idea of some ligament snapping during the manipulative treatment is experienced by other orthopaedists and if we are enabled to find out the structures snapping by some means, then I feel that the treatment period will be shortened and also made precise by an operative procedure to cut the structures and obtain correction instead of the prolonged and blind manipulative procedure with all its attendant vagueness and insecurities in the final result. Hence it is my appeal to orthopaedic surgeons in big hospitals to look out for cases of children dying of some other cases, but whose feet have been corrected, and find out the snapping structures with the help of the anatomist.

Sufficient time must be given to maintain the correction at first in plaster casing and next when the baby stands and starts walking by prescribing boots with an inward crooking for the sole and the heel instructing the mother to use the right foot shoe for the left and *vice versa* to attain the 20° of normal external rotation of the foot and also an eversion.

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#### DISCUSSION

B. N. Sinha, Lucknow.

The following table shows an analysis of cases of talipes equinovarus that attended the Orthopaedic section of the Gandhi Memorial and Associated Hospitals, Lucknow :—

TOTAL NO. OF CASES 387

			% age of total
Males	...	278	69.3
Females	...	119	30.7
Bilateral talipes	...	212	53.41
Unilateral talipes	...	169	42.56
Unilateral cases			% age of unilat. cases
Right side	...	80	20.13
Left side	...	89	22.43
			47.3
			52.7

#### AETIOLOGICAL CAUSES

			% age of total
Congenital	...	250	63
Acquired	...	135	34
Doubtful History	...	12	3
Miscellaneous	...	16	4.03

ACQUIRED CASES (Total No. 135)

	Cases	% of acquired cases	% age of total no. of cases
Post febrile	...	103	76.32
Spastic paralgia	...	2	1.48
Little's diseases	...	2	1.48
Traumatic contracture of tendo achilles	...	28	20.74
T. E. V. C. foot drop. (Nerve paralysis)	...	1	0.74
T. E. V. C. genuvarum	...	1	0.74
			0.24
			0.25

From this series, we find that the disease is more commonly a congenital than an acquired lesion, is more often bilateral than

unilateral and seems to affect the males more than the females. In the unilateral variety, the left foot is more often involved than the right.

*Aetiology*: Only a few factors are discussed:—

(a) *Influence of heredity*: Though in a few of my patients with congenital talipes, the parents gave a history of having suffered from a similar disease, in an overwhelming majority of cases, there was no evidence of any hereditary influence.

(b) *Diseases of the Nervous System*: I can remember only two cases where spina bifida occulta was the primary factor in the causation of talipes equinovarus. Although in various types of spastic paraplegia and other similar lesions of the central nervous system the complication of talipes equinovarus may arise, I do not think that there are enough facts and figures to label these as aetiological factors of congenital club foot.

(c) *Mechanical cause*: According to this theory the foot has been maintained in an abnormal position by external influences resulting in secondary changes in the muscles, ligaments and bones, particularly in the talus. These secondary changes cause the talipes equinovarus. It is difficult to appreciate this theory when we consider that the foetus does not lie in a fixed position, but keeps on moving inside the uterus. Moreover, no other parts of the limbs are affected and in unilateral cases the affected leg is slightly smaller in dimensions.

(d) *Developmental causes*: Having come across cases of myodystrophia foetalis, I feel that some developmental error is responsible for the causation of congenital "club-foot". In spite of authoritative statements to the contrary made elsewhere by others, I must mention here that the study of our series of cases has strongly impressed upon me the fact that the entire rotation of the



Fig. 1.



Fig. 2.

lower limb has been at fault in congenital talipes equinovarus. I feel that some developmental error in the rotation of the inferior limb bud may be an aetiological factor in the causation of congenital talipes equinovarus. Probably there is some developmental error, intrinsic in origin, affecting the muscles of the inferior extremity, particularly those of the feet. Developmental defects in the rotation of the limb bud may explain not only the various types of deformities in congenital club foot but also the diverse results of treatment—some cases being very easily rectified while others are very difficult to cure (Fig. 1 & 2).

I am not able to say as to why one limb is affected more often than the other; nor am I able to explain why there is a preponderance of this disease in one sex. I admit that the aetiology of congenital club foot requires a good deal of careful elucidation.

*Pathological Anatomy:* I will only mention some facts which have struck me.

(a) In the routine skiagraphy of these cases, I found the lateral malleolus absent in one case only. What this indicates, I cannot say.



Fig. 3.

(b) It must be emphasized very strongly that eversion of the foot takes place mainly

at the sub-taloid joint. Unless the correction of the deformity is made at this joint, various grades of recurrence of talipes equinovarus will persist (Fig. 3).

(c) In several cases, the defect was present not only in the tibia but also in the thigh, with a definite internal rotation at the hip joint.

The observations regarding contractures of the ligaments and muscles of the foot need no repetition here.

*Clinical varieties:* I have followed Brockman's clinical classification of congenital club foot;

(i) Group one cases are those where the treatment is undertaken in early infancy;

(ii) Group two cases are those in whom the treatment is started when the children are several months old;

(iii) Group three are those who have not been treated till late childhood or adult age.

I have found this classification a simple and practical one in laying down the basis for attempting a cure in this condition.

*Diagnosis and Physical Examination:—*

(i) No case of congenital talipes equinovarus should be considered examined unless and until the spines, the hips, the thighs and, last of all, the feet, have been properly exposed and inspected.

(ii) Results of the examination of the nervous system (particularly the action of the sphincters and the knee jerks) should be recorded.

(iii) The electrical reactions of the muscles of the legs and feet should be noted. (This was done in 37 cases in this series and it was interesting to note that the response was sluggish to faradic stimulation. This is in keeping with the conception of some developmental error in these groups of muscles; this also means that the correction of the deformity in talipes equinovarus must always be followed by proper physiotherapy and electrical treatment so that the muscles shall acquire the proper tone to resume the normal physiological function.)

(iv) As far as possible an x-ray examination of the feet both before and after treatment should be taken to appreciate the following points :

(a) presence and the relative positions of the various bones of the tarsus—the navicular and talus in particular.

(b) The presence and relative positions of the medial and lateral malleoli and a picture of the tibia.

(c) Skiagram of the hip and/or spine in those cases where an internal rotation of the inferior extremity or a spina bifida occulta is suspected.

*Treatment* : I may mention at the very outset that the treatment of talipes equinovarus is a prolonged one requiring a great deal of patience, both on the part of the surgeon and the patient. It is essentially a treatment of gradual manipulation, the duration, the degree and the type of manipulation varying with each individual patient. The technique of manipulation followed by us is as follows :—

The manipulation is started on the patient a few days after birth and comprises of massage with dusting powder to the feet and correction of the deformity. The nurse is asked to steady the knee joint by holding the lower part of the thigh and upper part of the leg so that any chance of traumatising the epiphysis of the lower end of the femur and upper end of the tibia is obviated, and

the proper leverage is obtained. The surgeon then uses his right or left hand as the case may be, putting his thumb on the prominence of the talus anterior to the lateral malleolus, steadies the lower end of the tibia with the index finger behind the lower end of the leg, and corrects the varus deformity by his middle and ring fingers placed on the medial side of the head of the first metatarsal bone. The pressure of the thumb is backwards and inwards while the pressure of the index finger is in the opposite direction. This manipulation should not be jerky and should be done with steadied force little by little. Our routine is to strap the feet with a roller bandage after the application of a lateral wooden splint which extends from the head of the fibula to 1" below the lateral malleolus (Figs. 4 & 5). The feet are in this corrected position for a few days. Over this bandage "Leucoplast" or "Elastoplast" is applied to reinforce it so that the movements of the feet may not loosen the bandage too early. Gradually when the child begins to tolerate this type of bandaging and splintage the degree of force is increased and the contracted spring ligament and other structures on the under-surface of the inner arch are broken so as to release the navicular bone to enable it to take up its proper anatomical position in relation to the head of the talus.

Although our technique of manipulation is almost the same as that of Dr. Kala-



Fig. 4.



Fig 5.

megham, his method of maintaining the correction by application of the "Elastoplast" directly on the skin has not been tolerated by our series of cases, and therefore, is not advocated by us as a desirable procedure. In addition to the irritating effect of the "Elastoplast" on the skin, the bandages very often become soiled with urine in spite of the best nursing. I have found that the use of the lateral splint helps the maintenance of the proper position of the corrected foot. Application of the lateral splint is done over four pads of cotton-wool one, thick enough, is applied in the position of the thumb over the prominence of the talus, a second just above the lateral malleolus, the third below the head of the fibula, and the fourth on the medial side of the first metatarsal bone so that when the bandage is passed round, the pressure is distributed thus avoiding bandage sores over the projecting bony prominences. This manipulation is done once daily, or every second day or twice a week depending upon the following factors :—

1. The rigidity of the foot. The greater the rigidity the more frequent is the manipulation.

2. If the bandages get soiled or loose the manipulation should be repeated.

3. If the patient is unable to tolerate the manipulation no attempt should be made to overdo it. It is better to manipulate more frequently to obtain the correction gradually than to traumatise the limb in one sitting.

4. If there are any abrasions or contusions at the pressure points in the feet they should be recognised early and the manipulation stopped so that the skin may become healthy for further treatment. I quite agree with Dr. Kalamegham that in every proper manipulation one should hear a snap which means that the tissues on the medial side have yielded. It is an important sign.

This manipulation is continued for weeks and months till the feet assume the corrected position or are supple enough to be brought up into the corrected position by the slightest force (Fig. 6). That is the stage



Fig. 6.

when we advise a further forcible manipulation, correction, or rather over-correction, and application of plaster of paris. During this stage it is perhaps better to give these patients a course of faradic stimulation between the manipulations so that the tone of the muscles may be improved.

*Technique of plastering:* The method of applying plaster of paris in our series of cases has been as follows: (Fig. 7)

- (a) Generally no anaesthesia is used;

- (b) Plaster is applied from the middle of the thigh to 1" beyond the toes, with the dorsal surface of the toes open for inspection.

With this plaster casing the child will not be able to break the plaster or get the case out of the leg which often happens, when the knee remains extended or out of the cast. The plaster case is maintained on an average for 4 to 6 weeks. At the end of this period, the plaster is removed, the skin is looked after for a few days, opened to the atmosphere, and is replastered in a further corrected position.

The plastering may be required 3 or 4 times in succession to get a complete correction of the deformity. At the end of it

the plaster casing is discarded and a proper course of rehabilitation is advised. Massage and faradic stimulation are recommended and at the same time the patient is fitted with orthopaedic shoes. He wears it day and

hours it should be taken off to clean the foot.

*Dennis Browne's Splint* : I have tried this method of splintage in these cases but I have not been able to succeed. I feel that there may be some fault in my method of applying the splint.

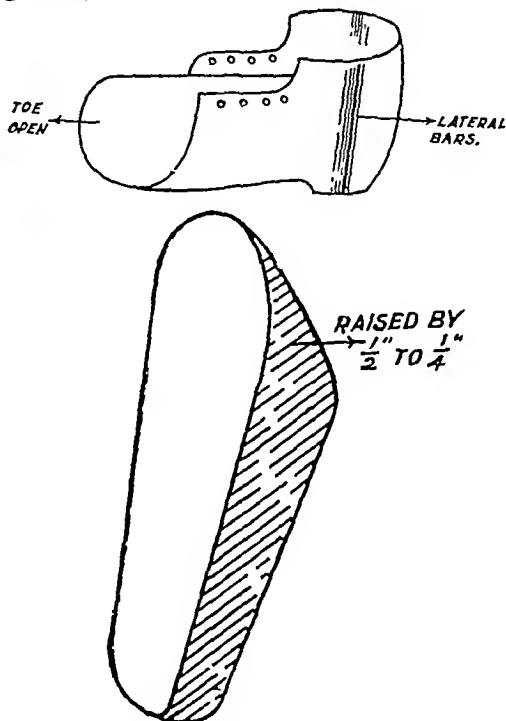


Fig. 7.

Fig. 8.

night with an interval of one hour every morning for cleaning and care of the feet. He should wear it till he comes to the walking age when weight bearing itself becomes an aid in the correction of the foot. The description of the orthopaedic shoes is as given below : (Fig. 8)

With the orthopaedic shoes in which the lateral side of the feet are raised by  $\frac{1}{4}$ " to  $\frac{1}{2}$ ", by putting his own weight and flattening out the arches of the feet, the patient is preventing the tendency to a deformity. The specifications of this shoe are as follows : The toes are open. It is a well-fitting boot with two side splints externally, and the outside of the sole raised on metal or stiff leather. The patient is advised to use this boot day and night except that once in 24

*Thomas's Wrench* : I have never found it useful for manipulation of talipes equinovarus. Firstly because I consider any severe trauma of this nature on a tender foot against the principles of manipulative surgery, and secondly because it may produce further complications by tearing the tissues and fracturing the bones thus vitiating the pattern of the foot in its future growth and development.

*Operative treatment of talipes equinovarus* : A large majority of these cases will not come to the stage of operative treatment if it is kept in mind that treatment is to be started as early as possible, i.e. when the child is a week or two old.

Here, I may be permitted to submit to my friends the general practitioners, that they should impress this point on the parents of these infants. One comes across so many cases where the children have been brought for treatment three months or six months after birth, either because they thought that the child was too young for starting the treatment, or the nurse or the attending doctor asked them to have the treatment a few months later. It is almost universally recognised that the sooner the treatment is started the better it is in the interests of the patient; the total period required for the treatment is reduced and the correction obtained is far better than when the treatment is started late.

The correction of this deformity is to be done in the following order :

(a) Varus should be corrected first, and the foot having been brought into a valgus position, *then and only then*, should the equinus be taken up.

(b) The equinus should be corrected by making an effort to push the talus inside the tibio-fibular mortice and gradual stretching of the tendo achilles. I may mention here that in our series of cases the operation of tendon lengthening has not been found necessary except in two cases.

We have performed the following operations in connection with this condition :

On the assumption of the pathology of a dislocated semilunar bone, Brockman's operation (which mobilises the navicular bone and brings it into proper apposition to the head of the talus) is very useful in selected cases. But there are a few patients in whom it is difficult to reduce the talus into the tibio-fibular mortice and in them (four cases in this series) I have found that a cuneiform resection of the body of the talus was a successful method of correcting the equinus deformity.

**Case Report :** Patient aged 14 years, Hindu female, admitted for correction of talipes equinovarus; cuneiform resection of talus was done by a lateral Kocher's incision, the foot corrected and plastered. Plaster was removed after two months, foot was fully corrected and the patient had a normal ankle joint. (Fig. 9 & 10).

In my opinion this operation has the advantage of permitting the reposition of the talus into the joint without damaging the joint surfaces so that the function of the ankles is not affected adversely.



Fig. 9.



Fig. 10.

In advanced cases where wedge resection is not enough, an excision of the head of the talus may also be needed. In cases that come very late arthrodesis of the pantalooid type may be needed. The lengthening of the tendo-achilles is not necessary in a large

majority of cases. I had to do it in two cases only, not because of pure contracture secondary to talipes equinus, but because the contractures had been made worse by scarring and burns in that area.

**Prognosis :** Prognosis as to the life of the child does not arise, and as regards the correction of deformity of the limb, it is fair. I personally think that the result cannot be considered really good unless and until the function of the limb is found to be almost normal. I may mention here that function is more difficult to regain in unilateral cases than in bilateral cases, probably because the child has greater difficulty in learning to walk correctly with a deformity on one side than when there is a disability on both sides. I would like to emphasize that rehabilitation after the course of treatment is over, is most desirable. Muscular exercises, teaching the patient how to walk and a course of faradic massage to the muscles of the leg and foot are essential to restore normal function of the limbs.

There are a few cases of congenital talipes equinovarus in which it has been found that the epiphysis of the tibia is affected so much so that the limb may require a raising of the heel to compensate for the shortening consequent on the arrest of growth in that particular leg. It may be suggested here that a greater number of skiagrams of each case may be of value and when possible a post-mortem be done to study the pathological anatomy of these cases.

N. S. Narasimhan, Madras.

In the Indian Journal of Surgery, Vol. II, No. 4, I analysed 172 cases of congenital talipes equino-varus regarding sex incidence, side affected, presentation during labour, heredity other deformities in the family, presence of other deformities in the patient, the patient's rank in the family, and consanguinity of parents. Further experience with 600 cases confirms these main findings and the findings are of importance in accepting or discarding theories of causation. Whitman in his orthopaedic surgery describes the foetal attitude as described by Eschricht (1851) and by Berg in 1882.

Eschricht described the foetal position of the lower limbs in the third month foetus. Middleton has noticed talipes in a foetus of 3 months. Dennis Browne says that compression force can begin its work in a foetus 12 mm. long. I studied the position of the feet in 117 museum specimens available in the Government Hospital for women and children, Madras and have described the findings in the Indian Journal of Surgery, Vol. II, No. 4. In 13 foetuses between the eighth and twelfth week, the position described by Eschricht was noticed only in two instances. Anatomy and embryology text books do not give adequate information on the position of the lower limb. Embryology models are available up to the 8th week. There is large gap in our knowledge on this subject and the hypothesis of intra-uterine pressure expounded from Hippocratic times requires more proof. Scudder (1887) and Hugen (1899) arrived at the conclusion that there is no essential relation between the age, rotation of the limbs and the position of the feet. While the mechanical theory explains in a bilateral talipes case why one foot is worse and more rigid than the other it does not explain (i) the greater incidence in boys than in girls and (ii) why some feet invariably recur after correction.

The theory of congenital dislocation was proposed as early as 1803 by Scarpa and by Brockman in 1929. This dislocation differs from other congenital dislocations in that the head is dislocated out of the socket and that the structures are rigid and stiff. Brockman's method of open operation was based on this hypothesis of dislocation: Brockman himself has abandoned his operation since 1937. Keith's (1940) idea of dysplasia explains the presence of other deformities in a talipes case. The heredity theory has a practical bearing. Prof. Haldane has brought out the importance of Eugenics in the study and prevention of congenital deformities of all types.

Coming to the practical question of availability of material for studies of the pathological anatomy, there are no dissected specimens of the deformed feet of talipes



at different age periods available in our teaching institutions. In a country where infantile mortality is so high it should be possible to secure specimens for study. The pathological anatomy is well recognised. True internal rotation of the tibia is not present. McMurray of the Liverpool School and Brockman and others have been teaching this for a long time. Although there is alteration in the body and neck of the astragalus it is recognised now that the bones by themselves are normal. The bony bump felt on the dorsum of the foot is the head of the astragalus and the scaphoid lies under the internal malleolus. It is described that the anterior fibres of the deltoid ligament of the ankle joint and the inferior calcaneo-navicular ligament are very much thickened. Brockman did not find them much thickened in twenty-six open operations. I found it very difficult to describe them as thickened at all. This operation finding is very important as excision of this astragalo-scaphoid capsule is practised by some in recurrent cases.

It has been possible in Madras to get these cases early in the first week after birth for treatment due to the co-operation of the staff of the public hospitals, nurses, midwives and child welfare centres. The general profession strangely has not yet become alive to the great advantage of early treatment.

It has to be explained to the parents that the treatment takes time, prolonged attendance is necessary and that after-care till the child walks well is required. The follow up reveals that 25% of cases recur and in this group are some cases which have been treated from the first week of infancy.

In India one would have noticed that elderly people with unreduced deformity of talipes go on working in the fields and on roads dragging heavy weights. From this it would appear that good looking foot is not necessarily a well functioning foot. The aim of treatment in talipes should be to obtain a supple plantigrade foot.

All are agreed that the deformity should be corrected by manipulation. The manipulation is always done under an anaesthetic if the baby is a few weeks old. Open ether is the anaesthetic used by me in my cases. Dennis Browne has advocated full correction at the first manipulation. I was able to get correction in some cases but in the majority of the cases full correction was obtained only gradually in two or three sittings.

Adduction is the deformity corrected first and then the varus. If the thumbs and fingers fail, a wedge is used over which the deformity is corrected. There are many methods of keeping the correction; in infants the adhesive strapping carried around the lower third of the thigh with the knee flexed is useful. The strapping is not applied over bare skin. Plaster casings are applied when patients come from distances and when patients cannot afford to attend very frequently. The plaster casing is applied over a good sheeting of cotton and is carried to the upper third of the thigh; children kick about and use the limb; although the muscles become thin they recover with use. Skin may become eczematous and has to be treated with zinc cream but the plaster casing is not discontinued; intermittent treatment leaves the foot stiff. Dennis Browne splint was not extensively used by me as I could not give away the splints to the outpatients; use in two cases with short feet did not give me satisfactory results; the fault was not with the splint as full correction could not be obtained even after open operation. Although it was a working rule not to use the wrench, Thomas's wrench for older children above three years of age was found necessary to obtain correction. The knack of using the wrench has to be learnt as it is a powerful instrument.

Non-correction of adduction and varus is the commonest cause of relapse. Even if tenotomies are done the foot need not get into a correct position; relapses will occur. Constant practice to assume the correct position and repeated attention on the part of the mother who should be taught to put

the foot into the correct position of eversion and dorsiflexion are essential. When the deformity is corrected it is my practice in the after-treatment to advise the use of boots with inside iron, outside T strap, and the outer border of the sole thicker by  $\frac{1}{3}$  of an inch with low heels to be worn day and night, except when they are taken off daily for exercises, massage and bath by the mother. I do not prescribe separate night splints or shoes. Dennis Browne prescribes night shoes for one to five years.

Brockman's or Ober's operation have not been successful in all the 26 cases in which they were carried out. In 12 cases the feet became stiff and required manipulation. Brockman himself has left off open operations since 1937.

In older children above 7, I have done osteotomy of the neck of the talus, cuneiform osteotomy of the os-calcis and cuboid without interfering with the articular surfaces. The foot can be corrected to a good position; open tendon-lengthening of the tendo-achilles also was done. The operation is done in a bloodless field produced by a sphygmomanometer cuff and not by a pressure tourniquet. The moulding is done after a week in plaster and the results are good: plasters require renewal every 3rd week and have to be continued for four months.

Older children require a wedge resection of the McMurray type. The correction observed is good. All stiff feet in bare footed people are disadvantageous. I have not done astragalectomy for talipes. I have been able to follow up a case of astragalectomy done at the age of eight, fifty two years ago in Bristol; the lady has a plantigrade foot; the ankles and feet are rigid. There is movement in the metatarso-phalangeal joints. She can go about on a cycle—she is slim but cannot walk. Astragalectomy has no place in the treatment of talipes.

The relapsed cases are divided into two sub-groups from the operative stand point.

(a) That of the long, comparatively slender foot where the osseous changes have

gone so far as to resist correction in spite of tenotomy of the tendo-achillis to overcome equinus, and forcible stretching followed by fixation in plaster of paris and braces, and where there is still gradually relapsing adduction of the forefoot, particularly toward varus.

(b) Another group which will include those cases of relapsed clubfoot consisting of a short stumpy foot in extreme varus. In many of these latter cases we find that the patient has by impact of walking produced hypertrophy of the cuboid, the foot being so markedly inverted and supinated that the weight of the body rests directly upon the cuboid. The peroneal muscles are undeveloped and elongated and the dorsal flexors of the foot are shortened and act as direct agents to increase varus and supination of the foot. These cases will require the McMurray type of wedge osteotomy or a triple arthro desis of the Dunn type.

Some of the difficulties I have encountered may be mentioned. In a hot climate the skin gives trouble. Vaseline gauze and zinc cream keep the skin fairly clean. Oedema is common in some cases after manipulation; the toes should be watched always for two or three days. Ulceration of the inner side of the big toe and the outer side of the little toe has been met with. I have seen gangrene of the toes in one case in a boy aged 12.

Inward rotation of the leg after the completion of the treatment has been met with in 10% of cases; I have found it difficult to cure; training in walking has improved the condition. Taylor's club foot brace, with pelvic band, to prevent inward rotation of the leg did not correct the walking in two of my cases. It is essential that the weak evertors and extensors should regain power. The recovery of the muscles is retarded when the child gets whooping cough or any other infectious disease of childhood as measles and smallpox. Whooping cough I have often found to be the worst of the debilitating illnesses. There is very bad recurrence of the deformity.

In two instances I have met with paralysis of the extensors and peronei with reaction of degeneration. I am not sure if this is in any way due to the pressure of the cuff for the attachment of the medial iron. I have met with shortening of the leg and shortening of the foot; and genu-valgum 4" in 6 cases. In all cases of tendon-lengthening or tenotomy of tendo-achillis one must take special measures to develop the muscle. Otherwise there is always marked difference in circumference by 2".

Relapsed cases require re-manipulation and moulding and good correction is observed upto 6 years; afterwards wedge osteotomy is required. I have not done triple arthrodesis for any of these cases. I have had 4 cases with anterior bowing of the leg

even in infants and genu-varum and they were corrected.

**T. G. Agarwal, Delhi.**

The treatment given by the two speakers is a very lengthy and prolonged affair. In the large series presented very few have been followed upto the legitimate stage of cure. This is no fault of the treatment and follow up which our Indian patients do not stick to.

Thinking this I do Tenotomy early in most of my cases. I have done this in about 50 cases so far and I have not regretted it. I would ask "what is against Tenotomy and why it should not be done." This will shorten the treatment from 18 months to 3-6 months.

## PEPTIC ULCER

by V. M. KAIKINI, Bombay.

Peptic Ulcer is one of the commonest diseases that affect the gastro-intestinal system, and is much more common than is usually supposed to be, as many of these cases are treated as gastric dyspepsia. This malady was once upon a time supposed to be rare among Indians; but we find it—especially the duodenal ulcer—is nearly as common in the southern and western parts of India as it is in the Western countries. However the Deccan and the Madras Presidency are more affected by this disease than the other parts of India. It is found practically among all the classes, but apparently the incidence is found to be more among the poorer classes, because they seek hospital treatment more than the richer classes who can afford the luxury of a Sippy Diet. Meat diet is found not to have any special influence on the etiology of the disease, as a good many of the patients are found to be strict vegetarians. Among the well to do classes doctors, pleaders, businessmen and priests, are found to be liable to get this disease. Among priests who are more or less strict vegetarians, irregularity as regards time, quality, and quantity of food was found to be present. Out of about 600 cases of peptic ulcer that I had the chances to examine, gastric ulcer was found in about 12 cases; and out of 187 cases of operation done for peptic ulcer only two were for gastric ulcer, the remaining being for duodenal ulcer.

This disease is found mostly in the young age between 25 and 35 years and many cases are known where the symptoms have completely disappeared after the age of 60, most probably due to the spontaneous healing of the ulcer by the senile atrophy of the gastric and duodenal mucous membrane.

### Etiology

There are many theories as regards the etiology of peptic ulcer, the majority of which are more or less vague and conjectural. A few of them are quoted here :

(1) *Autodigestion* : There is in the gastric mucosa a resistance to the digestive action, of its own secretion. A single round area might lose its resistance to gastric juice and may be starting point of an ulcer. Disturbance of internal secretion inhibits the local production of antipepsin and gives rise to cytotoxic substances. But there are no positive proofs about this theory.

(2) *Arteriosclerosis* and obstruction to circulation. Thrombosis of vessels leading to haemorrhagic necrosis in the presence of active gastric juice may lead to ulcer. But peptic ulcer is most common at an age when arteriosclerosis is rarely found, and few patients with this malady are found to have arteriosclerosis.

(3) *Oral infection* or spicy and hot food, are sometimes taken as the etiological factors in the disease. If these agents irritate any part of the gastro-duodenal area first and foremost, it is the fundus of the stomach, which should have been the most affected part by the peptic ulcer. But one finds in actual practice that it is the least affected. Moreover oral sepsis is so common among the hospital class of patients that one should have expected to get many peptic ulcer cases among them which is not the case.

(4) *Hyperchlorydria and hypertension*. These are contributory causes but not essential. Good many people are found to be suffering from hyperchlorhydria, but peptic ulcer is not found among them.

(5) *Predigested food and peptic ulcer*. The concept that peptic ulcer depends upon some nutritional disturbance seems to have experimental support. Weeche and Page found that of twenty two dogs which were kept on low protein diet in a study of nutritional oedema, 36% developed a true peptic ulcer. An additional 23% showed superficial erosions of the gastric and duodenal mucosa. Bollmaun and Mann reported that

many animals on which Eck fistulas were produced ultimately died of peptic ulcer.

(6) *Deficiency factor.* According to Upmark, in seven cases of Addison's disease 2 peptic ulcers were found. Addison's disease and experimental adrenalectomy are associated with peptic ulcer. This may be due to incomplete intestinal absorption of the nutrients. Peptic ulcer also occurs in disorders of the liver.

According to Somervell of Neyoor, deficiency of vitamin A and B, is the chief dietetic cause of peptic ulcer in South India. He says, "The effect of the deficient diet is to bring about changes in the myenteric plexus of the stomach and the duodenum, which bring about spastic secretory and congestive changes in these organs. At the same time the lack of protective vitamin A, lowers the resistance of mucosa to infection, and leads to a lymphocytic invasion of the mucosa and hyperplasia of the lymphoid follicles, which eventually rupture on to the surface forming macroscopic ulcer. Mr. Somervell propounds this theory on the basis of his experience that the majority of the cases of peptic ulcer in Travancore occurs among the inhabitants of the southern part of the province whose staple food is some tapioca like starchy material obtained from the stem of palmyra trees. But in this case it may be contested that some sort of toxin inherent in the starchy material may be responsible for the genesis of the ulcer and not the mere avitaminosis, because many people in other parts of India who are subsisting on 'starvation diet'—deficient in every form of vitamin—are found to be comparatively free from peptic ulcer. Moreover a large number of people on the coast of the southern parts of the Bombay province subsist on similar kind of palmyra starch as a supplementary part of their diet, but peptic ulcer is not common among them.

(7) *Toxaemic theory.* Toxins play an important role in the etiology of peptic ulcer although indirectly. Toxins may be intrinsic like a pathological appendix or

gall-bladder, or extrinsic like nicotine, physostigmine, and pilocarpine. Injection of these chemical poisons have been found to produce peptic ulcer, in animals experimentally, by overstimulation of the vagus. Thus these toxins produce peptic ulcer not by their direct action but by their action on the vagus nerve.

(8) *Neurogenic theory.* The digestive function is controlled mainly by the co-ordinated action of the sympathetic and parasympathetic nerves. The vagus is a secretory and motor nerve and is controlled by the sympathetic through the vegetative nervous centre in the cortex of the cerebrum. Before going into the details of the disturbances in the nervous mechanism we should find out the normal physiology of digestion, especially gastric digestion. In gastric digestion the so-called duodenal reflex plays an important part. There are many theories as regard the reflex, but I have tried to depict it diagrammatically, as follows (Chart 1):—

In the opinion of some physiologists the mere presence of hyperacid stomach contents causes the opening of the pyloric sphincter. But those who oppose this theory say that the people who are habitually taking hydrochloric acid keep their stomach contents acid constantly, and never suffer from any inconvenience which would follow rapid emptying of the stomach. So the more plausible theory seems to be that the rhythmic opening or closing of the pyloric sphincter depends on the difference between the chemical reactions of the parts on either side of the sphincter.

In short, working of the digestive process depends upon the proper functioning of the vagus nerve which co-ordinates with or is under the control of the sympathetic. Any dysfunction of the vagus gives rise to vagotonic condition causing hyperchlorhydria and spasmodic pylorospasm, which is the main factor in the genesis of peptic ulcer.

According to Thorlakson and Mehtzer—"Both the local and central factors are important, but the accumulating evidence sug-

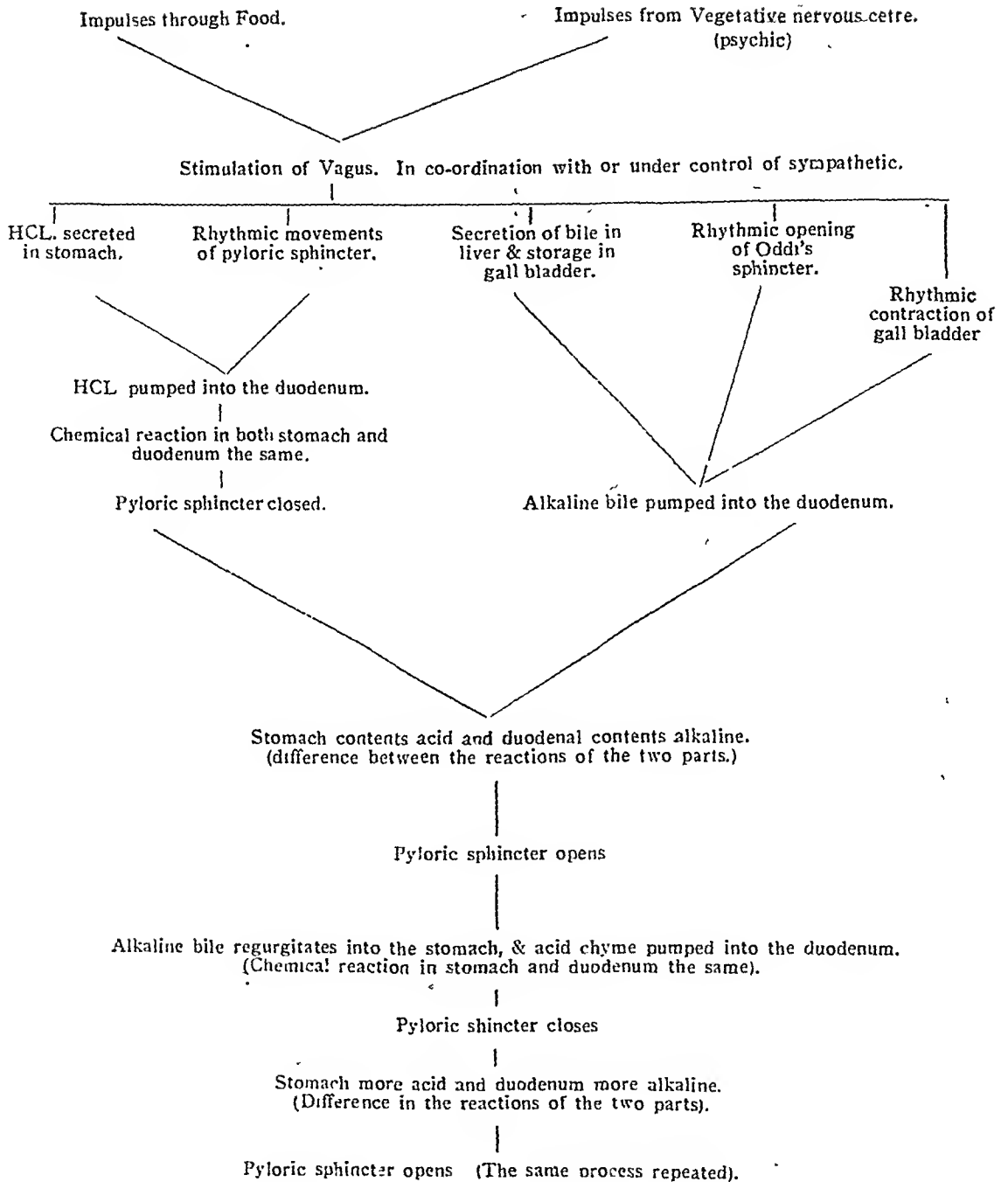


Chart 1

gests that central factors either in the nature of organic disease of the brain or the neurogenic stimuli from the cortex in a vagotonic type of individual, are fundamental or predisposing causes of peptic ulceration."

Local factors are bacterial invasion, trauma, acid chyme, erosions etc. But it is probable that their effect is secondary to the pre-existing central disturbance. Alteration in gastric motility and secretion and actual peptic ulceration may be produced by stimuli originating in higher centres. So when the predominating factor is the central, the ideal treatment is medical, or radical sur-

gery. If the predominating factor is local, medical treatment or conservative surgery is the treatment of choice.

Neurogenic hypothesis was suggested by Rokitansky. His evidence was based on three criteria viz. :—(i) The existence of cerebral lesions and peptic ulcers in the same individual. (ii) The occurrence of peptic ulceration in the infants following cerebral injury. (iii) There is considerable experimental evidence to show that induced vagal and sympathetic disturbances will produce ulcer in animals, not to mention the production of ulcer from stimulation or injury of cortical areas.

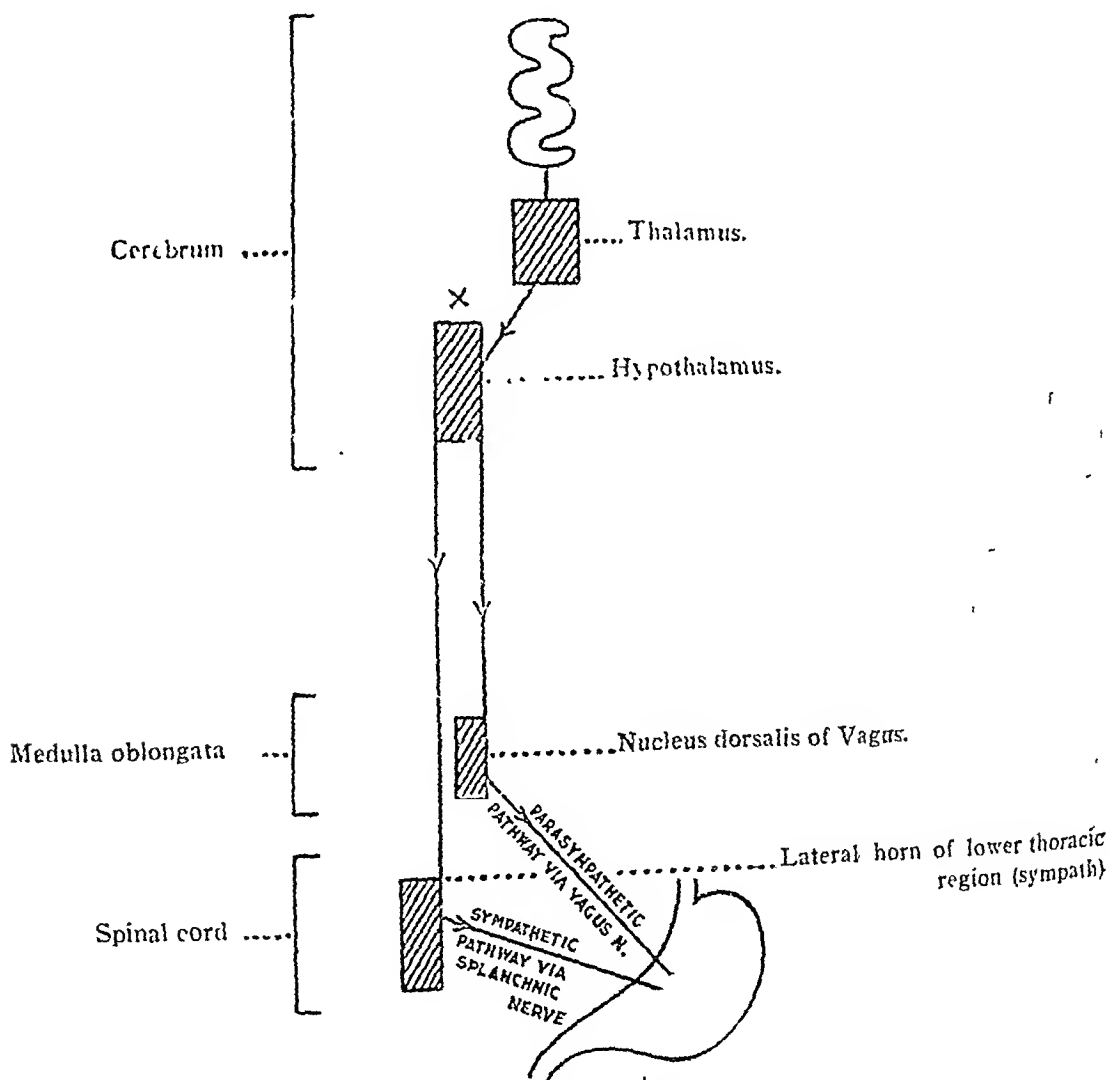


Fig 1. Nervous Control of Stomach

The arrows indicate the direction of the controlling impulses. The hypothalamus is known to exert some control over both sympathetic and parasympathetic systems; it may co-ordinate them. The nervous apparatus controlling the gastro-intestinal canal includes the cortex, the thalamus, and the hypothalamus. X indicates the irritation caused by a tumour. It may have affected the fibres going to the thalamus or the hypothalamus.

According to Cushing and Hoffmann cerebral tumours and injuries give rise to gastric lesions, haemorrhages, ulcers, etc.

Extreme rarity of peptic ulcer in infancy in the absence of intracranial lesions and the comparative frequency with which ulcers are found in association with brain injuries in the new born, suggests an etiological relationship between brain lesions and ulcer.

The sympathetic and parasympathetic nervous systems together constitute a balanced mechanism as far as gastric motility and secretion are concerned. Experimental attack on the vagus or sympathetic may result in gastric ulceration. Theoretically division of the vagus should not produce gastric ulceration. Actually however ulcers have been produced by this procedure. Manning Hall and Banting, in 1937, showed that prolonged vagal stimulation gives rise to areas of haemorrhage and congestion, in both pylorus and duodenum. Atropine prevented such lesions while eserine accentuated them and resulted in ulcer formation. Division of sympathetic pathways to the stomach gives rise to an uncontrolled vagus action. Gastric ulcerations and erosions have been recorded by a number of observers following section of sympathetic nerves to the stomach.

Schiff showed that stimulation of the vagus via the higher centres viz. the hypothalamus gave rise to the dilatation of the vessels in the stomach musculature. On the other hand stimulation of the sympathetic through the higher centres resulted in the constriction of the vessels in the stomach

mucosa and in decreased peristalsis. Elerstein injured anterior corpora quadrigemina and produced ulcers in 9 out of 23 experimental animals. Burdenko and Magilansky in 1925-26, punctured the hypothalamus and as a result obtained gastric erosions and perforations and in some instances chronic gastric ulcers.

Certain individuals may be described as vagotonic and these types are susceptible to ulcer formation. These people react excessively to certain vagal stimulating drugs, such as pilocarpine and physostigmine. Injection of these drugs and also pituitrine into the ventricles of the brain, were found by Bishop and others to produce gastric erosions, and other symptoms, similar to those resulting from vagus stimulation. These experiments suggest that the vagus has a controlling centre situated in the diencephalon.

During recent years the belief that 'anxiety factors' play an important role in the etiology of gastric and duodenal ulcers in man has been gaining favour. It has been always found that recurrence of an ulcer has been associated with a period of sustained anxiety or mental distress. It is well known that apprehension generally results in an inhibition of the motility and secretion of the stomach. Todd has stated that hyperactivity of the stomach is always present in the anxiety complex, and in patients consciously or subconsciously nervous but not afraid.

The splanchnic nerves are primarily concerned in the psychic inhibition of motility and because of the predominant motor effect of the vagus on gastric tone and motility, it is logical to assume that 'the anxiety hypermotility' just referred to, is primarily vagal in origin. Probably anxiety acts as a factor in the production of ulcer by affecting the motility of the stomach in such a way as to cause pylorospasm, hypermotility, or intragastric hypertension, and an associated retention with high acid continuous secretion during interdigestive phase.



Even highly potent gastric juice will not produce peptic ulcer without the existence of predisposing factors, like emotional upsets giving rise to localized circulatory disturbances, prolonged gastric retention, and excessive and prolonged gastric secretion, and also other factors including excessive use of alcohol, tobacco, food irritants, etc. Despite the arguments in favour of acid pepsin theory of ulcer formation, no valid claim can be made that the factor stands out as 'the specific cause' of peptic ulcer disease. But the predisposing factors must be present. It has been found that 75% of patients with gastric ulcer, and 20% with duodenal ulcer have low or normal acidity; whereas some individuals manifest typical hypersecretory curves without objective evidence of ulceration. So ulcer may be considered more as the result of peptic digestion than mere acid irritation. (Wimkelstein and others).

It is the experience of every surgeon that a vast number of peptic ulcer cases closely resemble certain diseases like asthma, in which some allergic condition plays an important role. Periodicity varies according to time, season, and place. In many cases history of neurosis in the family, and heredity are present. Thus there is every reason to assume that the nervous system plays the most important role in the etiology of peptic ulcer.

Out of the about 600 cases examined for peptic ulcer by me, the majority gave history of irregularity in their mode of diet as regard time and quality. History of excessive tea drinking, of alcohol and smoking was given by about 30% of cases. About 20% gave history of ulcer in the family—father or brother. It was found to be much more common among the Hindus than the Muslims, even taking into consideration the ratio of their respective population, and their comparative reluctance to get an abdominal operation done. This is important as regards meat eating being an etiological factor, because Muslims are comparatively more meat eaters than the Hindus. Among Hindus the Deccanis were

more affected than the Gujerathis. History of previous digestive trouble was given by very few. Nearly all said that their digestion was always good till symptoms of periodical pain began to appear. In the majority of cases the general nutrition of the patients was normal in the early stages.

### Pathology

Peptic ulcer is either gastric or duodenal. The so called pyloric ulcer is really a duodenal ulcer which has invaded the pyloric sphincter. Gastric ulcer occurs most commonly in the pyloric area of the stomach although a few have been found near the cardiac end and in the fundus. Duodenal ulcer is mostly found in the first part of the duodenum about  $\frac{1}{2}$ " from the pyloric sphincter.

Out of the 182 cases operated on for duodenal ulcer only in two cases the ulcers were found at the distal end of the first part of the duodenum. In about 25% of cases the ulcer had invaded the pylorus and caused obstruction. I am told this type of ulcer is more common in the Madras presidency.

In one case multiple polyposis of the stomach was present. According to Blahd polyposis occurs both in gastric and duodenal ulcers. Stomachs affected with polypoid gastritis are reminiscent of the infected and hypertrophied urinary bladder which has been pounding against an obstructed outlet. In both organs the hypertrophy pervades the entire wall, most marked however in the muscularis. In the case of the obstructed bladder the residual urine becomes foul and infected and gives rise to cystitis. In the stomach the greatly thickened gastric wall causes one to surmise a similar stagnation of contents resulting in polypoid gastritis. There is good reason to believe that polypoid gastritis in some way, is the result of an obstructed pylorus either functional or organic. Carrying on this line of reasoning to its natural conclusion the inference is that free unobstructed drainage should have a beneficial effect upon the inflammation.

### Symptoms

Pain is the most important symptom in peptic ulcer. The most common pathway in uncomplicated peptic ulcer is probably that which involves the visceral splanchnic nerves. The impulses originate in the walls of the gastro-intestinal tract, course along sensory bundles in the sheaths of splanchnic nerves, cross over through the white rami communicantes of the thoracic nerves, and pass along the posterior roots of the spinal nerves, thus reaching the posterior horn of the spinal cord. It is usually a diffuse type of pain, poorly localized, frequently associated with flatulence and usually not very severe although at times it may be colicky. It disappears leaving very little residual soreness or tenderness. Rigidity and hyperalgesia are absent. The stimulus has been assumed to be either an increase in pressure within the gastrointestinal segments, which results in stretching of circulatory fibres of the viscus or spasm, the result of hyperacidity. When the ulcer penetrates through the walls of the bowel and reaches the serous coat the sensitive cerebrospinal nerve twigs which supply the parietal peritoneum and mesentery, are affected and the pain is interpreted as being felt in the cutaneous and intercostal areas.

As regards the periodicity of the pain many theories are put forward, but none of them is satisfactory.

In *Gastric Ulcer* the pain commences from five to twenty minutes after the ingestion of food and reaches its maximum at the end of about two hours, after which it gradually declines and finally disappears at the conclusion of the period of gastric digestion. As a rule the pain is localised to the epigastrium in the median line of the abdomen about one inch below the tip of the ensiform cartilage. Pain in the back may also exist at any spot in the vertebra usually between the 11th dorsal and 1st lumbar, vertebrae, and slightly to the left of the median line. It may radiate up the sternum towards the shoulder. It is always increased by pres-

sure. Mental emotions, and intellectual overstrains are apt to excite an attack; so also sudden impairment of the general health due to some illness.

In *Duodenal Ulcer* the pain occurs two and a half to four hours after food and radiates to the right costal arch over the upper part of the abdomen and back and is relieved by food—the so called hunger pain. It starts very insiduously in the beginning and in the intervals the patient is free from symptoms and appetite is good. Pain becomes severe and constant when adhesions and pyloric obstruction occur.

*Vomiting*.—Vomiting is fairly common in gastric ulcer but is less constant than pain. In duodenal ulcer vomiting is less common than in gastric ulcer except when pyloric obstruction is present. When pyloric obstruction occurs vomiting is excessive in quantity, sour smelling containing an excess of hydrochloric acid, and is repeated at irregular intervals.

*Haemorrhage*.—Every case of gastric ulcer is accompanied by some oozing and the blood is eliminated by the bowel in a condition so changed as to escape recognition on casual examination, of the faeces. Sudden and profuse haemorrhage might occur in a chronic case by destruction of one of the larger gastric vessels. It is usually preceded by a severe pain occurring after a long interval. It usually occurs after a meal. Sudden exertion increased blood pressure due to heart or kidney disease may be the contributory causes. The patient becomes anaemic, restless, thirsty, cold, and prostrated. Pulse is quick and jerky. There are giddiness and noise in the ears. Urine is pale abundant and contains albumin. Haemetemesis and malaena are more common and profuse in duodenal ulcer.

*Disorders of digestion*.—In gastric ulcer these are usually present due to the co-existing gastritis. But in early cases of duodenal ulcer appetite is good, although the patient is afraid to eat under the impression that food is responsible for the

pain, and only in advanced cases there is loss of appetite.

In gastric ulcer well marked tenderness is present in the epigastric region just below the ensiform cartilage. In duodenal ulcer the tenderness is about 1" above and  $\frac{1}{2}$ " to the right of the median line. Local "tumour-like" feel is rare and is only present in very advanced cases.

*Heart burn* is extremely common although it occurs comparatively late. It is not due to regurgitation of HCL in the oesophagus as oesophagus and stomach are not sensitive to concentration of HCL. According to Hurst it is due to (i) liberation of alcohol or organic acids during attacks of indigestion and (ii) to the increased tension on the muscular coats of the lower oesophagus, due to excess of HCL in the stomach. Alkalis neutralize the acid and open the pylorus.

### Diagnosis

Gastric ulcer may be mistaken for the following conditions :—

(1) *Hyperacidity*.—The pain excited by ingestion of food develops one to two hours after meals. The intensity extends over the whole abdomen, and chest. Regurgitation of acid food might occur. These attacks are temporarily relieved by draughts of warm water, milk, or carbonate of soda. Vomiting is rare, haemetemesis never occurs, and localized pain of ulcer is absent.

(2) *Biliary Colic*.—The symptoms only appear at intervals, and occur independently of meals. The pain is more severe and commences abruptly. The chief site is the hypochondrium, and just above the umbilicus. Pressure affords some relief. Vomiting does not afford relief, and haemetemesis never occurs.

(3) *Abdominal Crisis of Tabes*.—This occurs when the stomach is empty and in this condition the knee jerks are absent.

(4) *Cancer of the Stomach*.—Sudden loss of appetite in an otherwise normal person is

the first symptom. Debility, loss of flesh, etc. precede the local phenomena. The epigastric pain is lancinating in character, constant, and less dependent upon the nature of the food. Nausea is most frequent in cancer and vomiting increases the pain. Profuse haemetemesis is rare, but small quantity of black blood mixed with mucus is frequently observed. Anorexia is an early symptom. Tumour in the epigastrium is more frequently felt. Free HCL is rarely observed in cancer, while it occurs in ulcer. Milk diet increases the pain in cancer.

Duodenal ulcer may be mistaken for (1) *chronic appendicitis* or (2) *cholecystitis*. In appendicitis radiation of pain is usually at or below the umbilicus and the clockwork-like regularity is not present. In chronic cholecystitis distress is more marked in the epigastrium than regular pain, while periodicity is never present. Hunger pain is absent in both the conditions.

(3) *Ankylostoma Duodenale*.—This trouble may be mistaken for duodenal ulcer. Pain is present in the periumbilical and epigastric regions. Diarrhoea with mucus may be present. Pain may be relieved by food; and tenderness may be present in the epigastrium. Many of these patients complain of erratic appetite sometimes voracious, and the sense of taste is altered. Duodenal cap appears dilated and gastric wall hypotonic. About three cases of this type came under my observation. One of these patients was from Madras, and two were local people. In all these cases hunger pain was present, but not with the same clock-work like regularity, as one finds in duodenal ulcer, and symptoms were more erratic. In two cases anaemia was well marked. Ankylostome treatment cured the condition.

One case which came to me in 1930 with symptoms of duodenal ulcer was found after opening the abdomen to be suffering from *gastric polyposis*. Gastro-jejunostomy was done. He was free from symptoms for many years; but when seen last year he said that he was getting symptoms of pain and distress after meals for the last few months. In

this case as stated above although gastric polyposis was the result of peptic ulcer, partial gastrectomy was the operation of choice and not gastro-jejunostomy.

### Complications

The four important complications are :—Perforation, haemorrhage, adhesions to surrounding structures, and pyloric obstruction.

*Perforation.*—This may be acute or chronic. Acute perforation is more common and occurs suddenly without any warning usually after a heavy meal or exertion. The symptoms are very vague and begin with very severe excruciating pain in the abdomen, which subsides after some time and may produce a sense of false security in the patient—the quiescent or dangerous period—after which symptoms of peritonitis combined with shock of an acute abdomen present themselves. But in the majority of cases classical symptoms of peritonitis like rigidity, vomiting etc. are not present, and the cases are mistaken for appendicitis and cholecystitis. The typical symptoms that should put the surgeon on guard in these cases are, sudden excruciating pain, the quiescent period, and the jerky type of respiration. The latter is due to the irritation of the crura of the diaphragm by the gastric contents.

Chronic perforation is comparatively rare and gives rise to intermittent severe pain, and later on to subphonic or local abscess. In chronic cases adhesions are found between the stomach and the pancreas giving rise constant pain and tenderness. Pyloric obstruction gives rise to all the symptoms of obstruction, vomiting, continuous pain, dilatation of the stomach.

### Treatment

The choice of the treatment must depend upon the etiological factors which produce peptic ulcer. The latest opinion seems to be in favour of regarding the vagotonic condition as being the most important etiological factor in the genesis of peptic ulcer. This

gives rise to abnormal secretion of HCL, and at the same time induces irregular pylorospasm. The vagus nerve is stimulated by impulses (psychic) from the vegetative nervous centre in the cerebral cortex, or by toxins, intrinsic, or extrinsic—and by irregularities in diet as regards time, quality etc. In short the neurogenic factor is the most important one in the etiology of the disease. The treatment is either medical or surgical. Operative treatment should not be undertaken without a trial being given to medical treatment unless the disease is of long standing.

*Medical Treatment.*—To eliminate the immediate agent of tissue destruction the acid factor, the following treatment is used at present :—(i) Atropine—vagosedative—to lessen the production of hydrochloric acid, and to minimize the retention of gastric secretion. (ii) Alkalis to neutralize gastric H.C.L. (iii) High fat diet to inhibit acid secretion. (iv) Frequent feedings to absorb dilute acids, and sedatives to inhibit the nervous secretion of acid and pepsin. (v) And gastric aspiration to remove excess of retained gastric juice. Chronic peptic ulcer is a life long disease. "Once peptic ulcer, always peptic ulcer." Only a small percentage of patients are cured by medical treatment in case the disease is well established. The ordinary Sippey diet seems to be inadequate because it does not control acidity between the meals. There is a high secretion of acids during the night even while the patient is on Sippey diet during the day. Frequent Sippey feedings may in themselves serve as an added stimulus to the nervous phase of acid secretion and may not allow sufficient functional rest, motor or secretory. Other disadvantages of Sippey diet are, according to Winkelstein, and others, (i) the diet is nutritionally deficient and is increased too slowly, (ii) it necessitates a bed routine, (iii) remissions after Sippey treatment are short and recurrences are often very severe, (iv) the large amount of absorbable alkalis used may lead to a harmful systemic alkalosis in the presence of renal dysfunction, and (v) it does

not constitute an adequate means of effecting inter-digestive neutralisation, especially of the night secretion.

Many drugs are in the market which contain aluminium hydroxide, and also other alkaline preparations. Protein shock and vitamin therapy, have also been tried, but the results have not been very encouraging. Lately a preparation of gastric and duodenal secretions called "Robudin", has been advertised, but as it is a new one, one has to wait to see its results.

Hypersecretion and hyperacidity, are the most frequent precipitating factors. The peptic ulcer patient must abstain from those activities which increase gastric secretion, and acidity—smoking especially cigarettes, ingestion of alcohol, and condiments. Neutralization of gastric acidity is favoured by a diet consisting of frequent small feedings, as food is an important neutralizing agent. Alkalis are probably of less value than formerly considered. Sodium bicarbonate is not an efficient neutralizing agent because there is, frequently, a rebound hyperacidity even greater than that before the administration of the alkali. There is also danger of alkalosis from the use of excessive amounts. The alkali of choice is calcium carbonate 10 to 20 grains. Mucin also controls acidity. Pylorospasm is controlled by tr. bellad 10 to 20 minims. (Alton Ochsner and others.)

*Surgical.*—In old cases which have not yielded to medical treatment and cases with adhesions and pyloric obstruction operation is indicated. There are many methods of operation which have been advocated; but gastro-jejunostomy and partial gastrectomy have been found to be the most successful, especially the latter. The third method which is being given a trial now-a-days is intrathoracic vagectomy. Gastro-jejunostomy is the usual posterior gastro-jejunostomy. It is a comparatively simple operation and with proper pre-and post-operative treatment gives good results and the mortality is low. It has been always emphasised that no loop of the jejunum should be left in the process of anastomosis, lest regurgita-

tion of stomach contents might occur. But in my case I have always been leaving a loop of jejunum but have not found any trouble of regurgitant vomiting.

The other and more sound operation is partial gastrectomy. It is the operation of choice for gastric ulcer, and for duodenal ulcer it gives much better results than gastro-jejunostomy. To get the best results viz. reducing the acid producing capacity of the stomach, at least two thirds of the distal portion of the stomach has to be removed. The method I have been following is the one advocated by De Courcy, with some modifications. The method is as follows:—  
(i) Ligament of Trietz located and jejunum gently clamped to be at hand when required for anastomosis. (ii) Division of gastro-colic omentum is started well up in the stomach. (iii) Gastric vessels are gently stripped from the stomach wall with closed haemostat for a distance of 1" before being divided. This allows sufficient room to place the stomach clamps without interference of the adjoining omentum and allows perfect co-aptation at the angles during anastomosis. (iv) Stomach clamps are applied and stomach divided between them. About  $\frac{1}{4}$ " is left between the upper clamp and the tied arteries. Gastro-jejunostomy is done (anto-colic). (v) The dissection of the gastro-colic and gastro-hepatic omentums, is made from above downwards. (vi) Strip duodenum clean so that suturing will bring peritoneum to peritoneum. (vii) Distal portion of stomach, and duodenum are removed last. But in my case I have not tied any of the individual blood vessels at the site of the anastomosis, and after suturing with catgut interrupted linen sutures were inserted in every layer. Clamps were used in every case. Stomach tube was inserted at the time of the operation and kept in for about three to four days draining the stomach continuously. Two blood transfusions were given one before and one after the operation.

In all eight cases of partial gastrectomy were done by this method, for duodenal

ulcer. Except for a rise of temperature after the second blood transfusion there were no complications. In fact the post-operative course seemed to be much smoother than in gastro-jejunostomies done by me. About two-thirds of the stomach was removed. In two cases the ulcer was found to be in the distal portion of the first part of the duodenum and about one-third of the first part of the duodenum was removed but the portion containing the ulcer was left alone. In one of these cases the first part of the duodenum was so adherent to the pancreas and the surrounding tissues that the distal portion of the stomach and the proximal portion of the duodenum had to be removed in two pieces. In the other case the stomach was very much dilated and no ulcer was detected in the pylorus or adjoining portion of the duodenum. But the distal portion of the first part of the duodenum looked fibrosed with adhesions indicating the presence of an ulcer. Moreover radiological examination showed the presence of a duodenal ulcer. Partial gastrectomy gave very good results and the post-operative course was extremely smooth. Both these cases gave very good results after the operation of gastrectomy.

The third method of operative treatment is removal of vagus innervation of the stomach by doing intrathoracic vagotomy. It has been found that ulcer patients secrete more of gastric juice in response to Ewald's test meal and other stimuli like alcohol instillation, and injection of histamine, than do ordinary normal persons. Acting on the conception that the hypersecretion of gastric juice in peptic ulcer is neurogenic in origin, vagus innervation has been removed. Complete division of the vagi, has been done in the thorax. In addition to the main trunks of the nerves which lie alongside of the oesophagus smaller fibres of the vagi, which penetrate the oesophageal wall, are identified ligated and divided above the diaphragm. The results have been declared to be satisfactory and being a comparatively easy operation it is very useful in jejunal ulcer. But how far the results are perma-

nent, is yet to be seen, because as shown by the experiments of Manning Hall and Banting, the after results of the division of the vagi are not definitely conclusive (vide p. 6). I have no personal experience of this method. "The status of vagus section is uncertain in gastro-jejunal ulcers as they are notoriously difficult to heal without resection" according to Dragstedt.

### Mortality

In the 8 cases of gastrectomy (partial), for duodenal ulcer, there were no deaths, Gastro-jejunostomy was done in 179 cases for peptic ulcer and the mortality was 7, i.e. about 3.9%. Out of these operations only two were for gastric ulcer the rest being for duodenal ulcer. The majority of the deaths occurred in the early days of my surgical career when the use of the stomach tube and blood transfusion were not common. In one case a debilitated man with dilated stomach and pyloric obstruction, with systolic blood pressure about 65 mm. gastro-jejunostomy was done without blood transfusion or any attempt to raise the blood pressure, which brought on fatal results. One case of post-operative persistent bilious vomiting could have been definitely saved by the use of a stomach tube. In two cases which died of haemorrhage consecutively, the clamps were used with the rubber covered blades facing in the opposite directions, and the ends of the blades inserted in the rings provided near the handles. Thus the handles compressed the stomach wall as firmly as by haemostatic forceps, and this later gave rise to severe haemorrhage which proved fatal. I had never used the clamps in this manner before, nor were they used in the manner after this accident, and I never had any post-operative complication of haemorrhage. The clamps are to be used only for steadying the bowels to be anastomosed and not for haemostasis. In the other three cases proper pre- and post-operative precautions, I am sure, would have reduced the mortality.

### Presentation of Cases

Out of the 179 cases on whom gastro-jejunostomy was done only two were found who developed jejunal ulcer. Among the oldest cases operated, one patient operated in 1925, and another in 1928, have been reporting themselves to me fairly regularly, and they have been keeping very good health and have no trouble of any sort with digestion although for some years they have not been observing any restrictions as regards diet. Among the other cases the following are rather interesting ones:—

Case 1. Mrs. D. Parsee. Admitted in 1928 for abdominal pain of four years duration. She was being treated for cholecystitis by a physician, but found no relief. A suppurating appendix had been removed two years previously. Duodenal ulcer was suspected and radiogram showed a very early lesion. She was advised medical treatment as it was a very early case, but she insisted on getting operated. She was carrying three months at the time and was having slight uterine bleeding with pain. Obstetric surgeon's opinion was taken and he advised that no operation was to be undertaken as she was getting uterine contraction with bleeding. But as she persisted on getting operated saying that she could not bear the gastric pain, I did gastro-jejunostomy on her. Convalescence was smooth except for some vomiting which stopped easily. She felt much better after the operation, abdominal pain disappeared, and she was delivered of a healthy baby in due course. After the operation all her stomach symptoms disappeared but she got an attack of pyelitis during the second delivery. Unfortunately I heard from her husband a few weeks back that she died of an attack of diphtheria in a provincial town where she was working as a doctor in charge of a female charitable hospital. This was an early case of duodenal ulcer and medical treatment could have been tried. All the same gastro-jejunostomy gave the patient complete relief.

Case 2. Patient aged about 45, well-built admitted in 1928 for epigastric pain suggestive of duodenal ulcer. Duration 9 years. Skiagram showed cholecystitis with stones. Cholecystectomy gave complete relief.

In this case the patient gave history of hunger pain periodicity etc. exactly typical of duodenal ulcer. There was no loss of appetite which is usually present in chronic cholecystitis of some years duration.

Case 3. Female patient aged about 60, admitted for abdominal pain of many years duration, with relation to meals, and tending to be more or less constant lately. Tenderness present in the duodenal area. Duodenal ulcer was suspected. Radiologist said that screening did not show a definite ulcer. On opening the abdomen a nodular feel

was noticed in the pyloric area. This together with the history made me think that it was a definite case of duodenal ulcer, and gastro-jejunostomy was done. The patient died on the fifth day. Post-mortem examination excluded the presence of duodenal ulcer.

In this case the history and the nodular feel at the pylorus misled me and an operation was needlessly done on an old debilitated patient. The nodular feel at the pylorus was perhaps due to strong spasmodic condition of the pyloric sphincter.

Case 4. Patient aged 25 admitted for pain in the lower abdomen in 1926, and symptoms resembling appendicitis. There was no hunger pain or periodicity which would make one suspicious of duodenal ulcer. Appendix was removed which gave relief to the patient. But he came again after six months complaining of pain which was referred more to the upper abdomen. X-ray revealed a duodenal ulcer. Gastro-jejunostomy gave complete relief.

Case 5. Old man about 60 years old admitted in January 1948 for constant abdominal pain loss of appetite vomiting, and great emaciation. He was not definite about the duration of the symptoms. At first he said that the trouble was only of one years duration, but later on when again questioned after the operation he said that he had the symptoms for at least two years. The subjective and objective symptoms indicated the presence of gastric carcinoma. Skiagram also showed a picture typical of malignancy. On opening the abdomen more than half of the stomach was found to be involved in fibrosis due either to malignancy or very chronic gastric ulcer. But glandular involvement and adhesions were absent and the stomach was freely movable. But practically the whole of the lesser curvature was involved in the fibrous process. If gastrectomy was to be really effective the whole stomach would have had to be removed which was not advisable on account of the debilitated condition of the patient. So posterior gastro-jejunostomy was done and the patient was free from pain vomiting and other symptoms and improved much in health. So most likely the case was one of gastric ulcer of long standing and the patient gave a misleading history. Moreover the X-ray picture also was rather misleading and typical.

### Conclusions

1. Peptic ulcer is a very common disease and more common in the Deccan and Madras Presidency than in Gujrath and Northern India.

2. Meat eating has no importance as an etiological factor of the disease; but heredity, irregularity about food, and chiefly neurogenic factor



play an important role in the genesis of the disease.

3. Medical treatment has a limited scope in the treatment of the disease, and should be tried only in the early cases. Surgery, especially partial gastrectomy is the treatment of choice, although gastro-jejunostomy gives good results in some duodenal ulcer cases.

4. Partial gastrectomy is not a very formidable operation and with proper pre- and post-operative treatment gives very good results, and the mortality is very low.

5. In the Western countries the appendix is usually removed when the gastric operation is done, as according to the experience of the surgeons there the appendix is always affected. But according to my experience the appendix is rarely involved in patients with peptic ulcers in India. In only three cases of peptic ulcer I had to remove

the appendix as it was involved. In no other cases were there any symptoms in the patients which indicated the presence of a pathological appendix.

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## A CASE OF A XIPHOPAGUS MONSTER\*

by R. NIGAM, Nagpur.

The chief interest in the case described here lies in its rarity. A similar case was described by Bland Sutton (1922). His patient, Laloo was a similar xiphopagus conjoined twin and by a strange coincidence was a male Hindu and a resident of United Provinces, India, similar to the case recorded here. Laloo was 18 years old at the time of recording and no description is available about his internal anatomy. In the case described here however the anatomy was studied, in detail and some interesting points have been observed. In the description the host will be referred to as the autosite and the parasite as the parasitic foetus following the terminology of Bland Sutton. Other cases have been recorded Ballantyne, J. W. (1910). Schwalbe, E. (1910).

The patient Prem Narain, Hindu male about 2 months old, resident of United Pro-

vinces, India, was sent to hospital by the obstetrician for surgical treatment. It was a case of uniovular twins, the autosite was a well developed male child, and attached to its chest and upper abdomen was a partially developed parasitic foetus. The parasitic foetus was half the size of the host (Fig. 1), had no head and possessed two upper limbs each with an arm, forearm and hand, with rudimentary fingers two in the right hand which were free and three in the left hand which were fused to each other. The lower limbs were well formed with a thigh, leg and foot and a complete set of toes. A transmitted impulse was felt in the parasite's abdomen when the autosite cried. This indicated peritoneal continuity between the two. The external genitalia were male and well formed but the testicles had not descended into the scrotum on either side, while those in the autosite possessed an umbilical cicatrix 1" below the attachment of the pedicle between the two. The parasite voided urine normally and independently of the autosite. A proctodeal dimple was present but the anal membrane was imperforate; an impulse could however be felt when the autosite cried.

A few days after admission a small opening appeared just above the proctodeal dimple and a little meconium was passed by the parasitic foetus. Again the bowel action of the parasitic foetus was independent of the autosite both in the time of action and the nature of stool passed, the autosite passed a normal stool while the parasite only passed a little meconium.

The parasitic foetus was colder than the autosite and possessed no active or reflex movements. On pinching the parasitic foetus the autosite cried thus showing some sensory appreciation across the pedicle (Fig. 2).

Although the child was only two months old, the mother was anxious for removal of the parasitic part. Preliminary investigation to ascertain the contents of the pedicle were done in the form of a radiograph be-

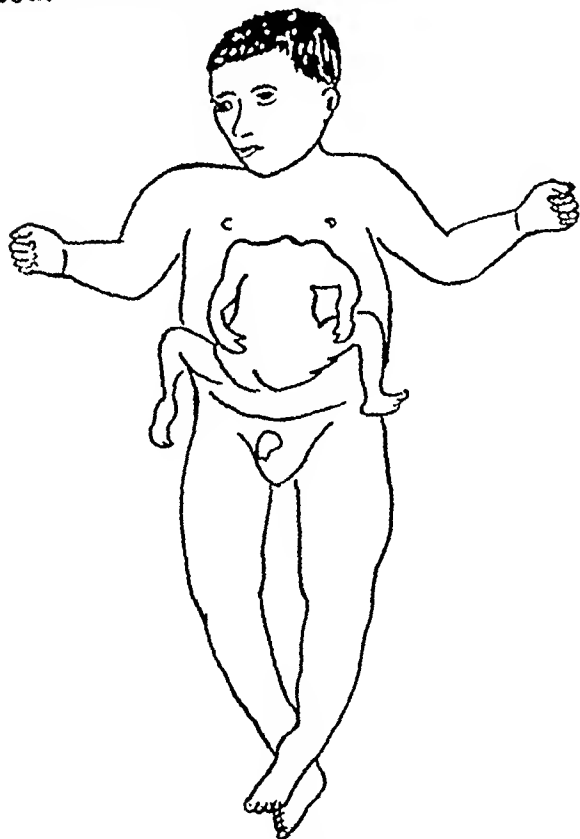


Fig. 1.

\*A short paper presented at the Tenth Annual Conference of the Association of Surgeons of India, Dec. '48.

fore and after a barium enema was given to the host. The barium failed to reach the site of the pedicle. The only attachment felt was a bony one to the xiphoid of the host.

The operation was performed under local anaesthesia. A cartilaginous attachment was found in the upper part of the pedicle and in order to prevent accidental opening of the chest of the autosite a part of the upper limb girdle of the parasitic foetus was left attached to the host. A peritoneal sac was found containing a loop of bowel apparently a fistula between the bowel of the autosite and the parasite. As the child's condition was not satisfactory the loop of bowel was not traced any further but was divided. At the lower part of the pedicle the urachus of the parasitic foetus was found and divided. The wound was rapidly closed and the divided loop of bowel anchored to the wound. The child progressed satisfactorily till the third day when he showed signs of intestinal obstruction and peritonitis and died on the fifth day. An ileostomy was

performed to relieve the obstruction but was of little value.

#### POST-MORTEM REPORT

(1) *The Autosite.* (Fig. 3.) A well developed male child length  $23\frac{1}{2}$ " with a stitched abdominal wound. The upper limb girdle of the parasitic foetus was attached to the xiphoid process of the autosite by a thin piece of cartilage  $\frac{1}{4}$ " wide. Above this attachment was an opening in the sternum of the autosite for a large vessel which on further dissection was found to be the right internal mammary artery, the main arterial supply of the parasitic foetus.

The abdomen contained purulent fluid. The cut loop of bowel divided at the time of operation, was traced and was found to be continuous with a collapsed gangrenous coil of colon, caecum and small intestine which terminated proximally in a blind duodenum. These were the intestines of the parasitic foetus which were lying in the right paracolic gutter of the abdomen of the autosite in a separate peritoneal sac, with



Fig. 2.

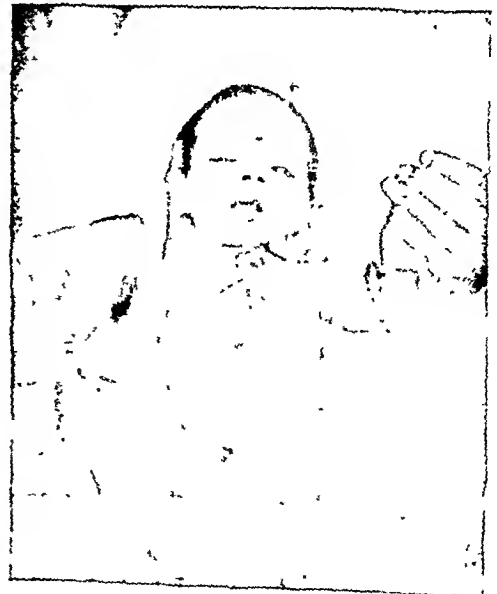


Fig. 3.

no communication with the bowel of the autosite. The other abdominal viscera of the autosite were normal. The liver received two other veins in addition to the portal vein of the autosite (Fig. 4). These were the superior and inferior mesenteric veins of the parasitic foetus. The kidneys and bladder were normal.

The umbilicus was normal and contained the remains of the obliterated umbilical arteries and an umbilical vein which was large and partially obliterated.

The heart was large with hypertrophy of the left ventricle. A very large right internal mammary artery was traced from the point of its emergence just above the xiphoid into the first part of the right subclavian artery of the autosite. The accompanying vein was also large and was the main venous return of the parasitic foetus. This entered the left innominate vein of the host. It crossed the superior mediastinum receiving some thymic veins from a large thymus gland. There was a patent ductus arteriosus half an inch long and sixth of an inch in diameter connecting the pulmonary

trunk to the aortic arch beyond the origin of the left subclavian artery. It had the usual normal relation to the vagus and the recurrent laryngeal nerve. The chambers of the heart showed a comparatively large right auricle and a patent foramen ovale. The walls of the left ventricle were hypertrophied.

(2) *The Parasitic Foetus* (Fig. 5 & 6). The parasite fourteen inches long, had but one coelomic cavity—the abdomen—there being no thorax. The upper limbs articulated with a rudimentary upper limb girdle which was a mass of hyaline cartilage fixed to the xiphoid cartilage of the autosite. There was no head and no vertebral column.

The upper limbs were rudimentary possessing an arm, forearm, hand and fingers, two present in the right hand and three in the left. The skeletal elements consisted of humerus, radius and ulna.

The major part of the intestine of the parasitic foetus, the duodenum, the jejunum, the ileum and part of the colon were contained in a distinct pouch of peritoneum in

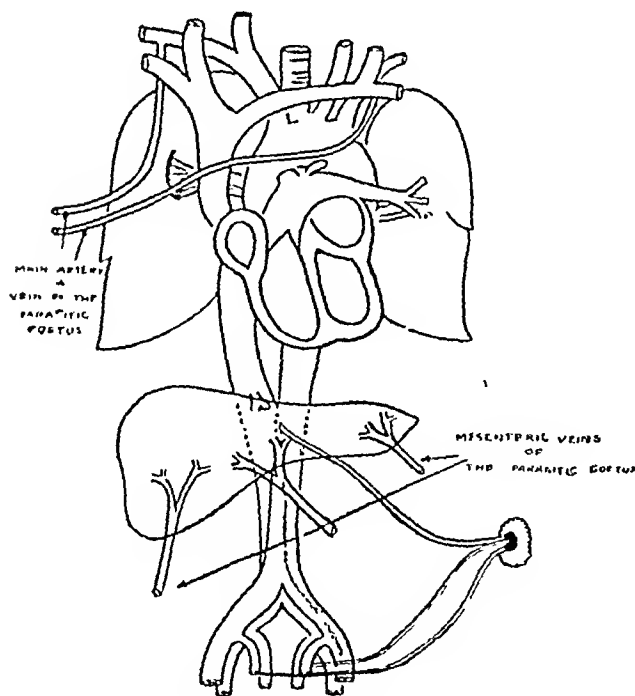


Fig. 4.



Fig. 5.

the abdomen of the autosite. The distal part of the colon only was present in the parasite (Fig. 7). There was a large horse shoe kidney occupying most of the abdominal cavity. The two kidneys were fused posteriorly with their hila pointing forwards, that of the right kidney was placed at a lower level than that of the left. The ureters were distinct and were traced to an abdominal bladder. The urachus was patent and was traced into the pedicle where it had been divided during the operation. There was no communication with the urachus of the autosite. On each side of the fused kidneys was a retained abdominal testicle with epididymis and a vas deferens running normally to the bladder. At the lower pole of each testicle was a gubernaculum which could be traced to a well defined inguinal fold.

In the mesentery of the intestine three localised masses of undifferentiated tissue were found:—

(1) A chocolate coloured nodule one quarter of an inch in diameter situated close

to the duodenum which on histological examination, was found to be a rudimentary spleen.

(2) A large greyish firm mass  $\frac{1}{2}$ " x  $\frac{1}{2}$ " lying in the mesentery near the ileocaecal region, which on histological examination consisted of lymphoid tissue.

(3) Another small nodule  $\frac{1}{4}$ " in diameter in the mesocolon near the kidney was a single suprarenal gland.

The vascular supply of the parasitic foetus arose from the right internal mammary artery of the autosite. This was the only arterial supply to the parasite. It supplied the upper limbs and then gave two mesenteric vessels to the small and large intestines of the parasite foetus. It gave one branch to each of the testicles, skirted around the right side of the horse shoe kidney, gave several branches to the kidney and then passed on to the posterior abdominal wall in the region of the right iliac fossa where it gave an axial artery to the right and left lower limbs. The branch to the left lower limb passed behind the rectum.



Fig. 6.

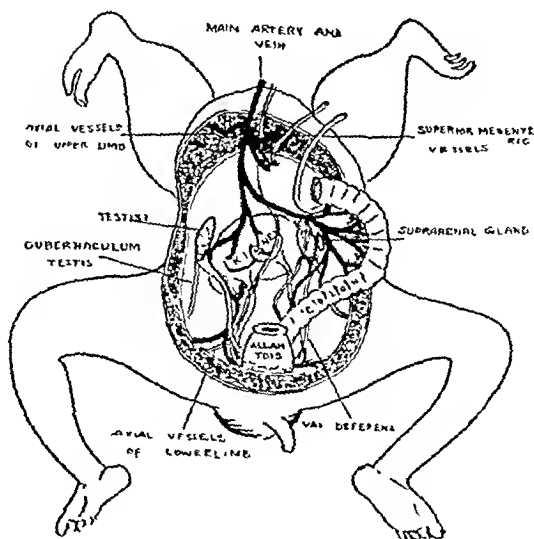


Fig. 7.

The accompanying systemic veins followed the artery and terminated into the right internal mammary vein of the autosite.

The portal venous system of the parasitic foetus consisted of two veins, the superior mesenteric vein which entered the right lobe of the liver, and the inferior mesenteric vein which entered the left lobe of the liver of the autosite.

The lower limbs each had an axial artery and a vein, but no nerves could be traced to the limbs. The muscle masses were pale. The skeletal elements of the lower limbs were well formed. A centre of ossification had appeared in the lower end of the femur.

There were no nerve trunks traceable from the host to the parasite across the pedicle. A leash of fibres resembling the mesenteric plexus of nerves was found while dissecting the mesenteric vessels.

The cause of death of the autosite was due to peritonitis following gangrene of the loop of bowel of the parasitic foetus which was lying in the autosite's abdomen. The blood supply to this segment of bowel had been cut when the main artery of the parasitic foetus had been tied off at operation in the region of the upper limb girdle during the division of the pedicle.

(3) *The Pedicle* (Fig. 8). Size  $3\frac{1}{4}'' \times 2\frac{1}{2}''$ . This contained a cartilaginous attachment to the xiphoid of the autosite, the main artery and vein of the parasitic foetus, a pouch of peritoneum with a loop of colon of the parasitic foetus, which was divided across at the time of the operation, two mesenteric veins, the superior mesenteric artery, and the urachus of the parasite. The umbilical cicatrix was situated in the abdomen of the autosite and not on the pedicle as was the case in Laloo recorded by Bland Sutton.

The circulation was maintained by a single heart. There was only one liver between the parasitic foetus and the autosite serving for the portal circulation of both the autosite and the host. A spleen and a

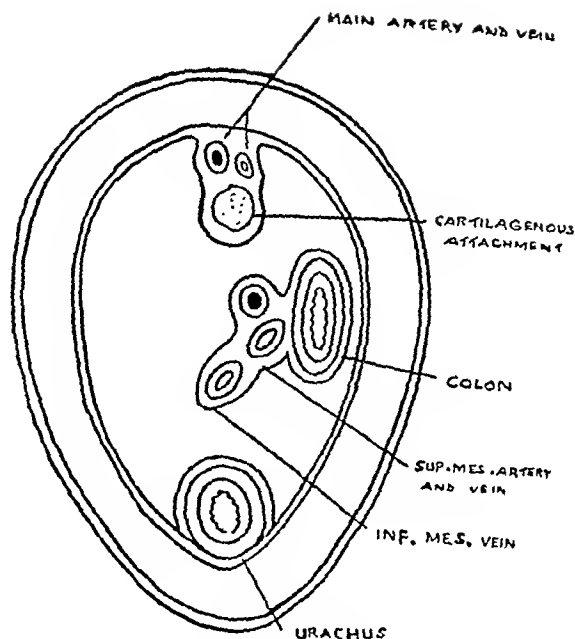


Fig. 8.

single suprarenal gland were also present in the parasite. The intestinal tracts of the autosite and the parasitic foetus were quite separate. The greater part of the intestines of the parasitic foetus were in the abdomen of the autosite in a separate pouch of peritoneum. Had this herniated loop of bowel been removed at the operation along with the parasitic foetus the host might have survived.

The embryological development can be explained by a posterior dichotomy in which the splitting of the primitive streak took place caudally and as far forwards as the region of the upper limb girdle. No head or vertebral column were formed in the parasitic foetus. The autosite was a normal well developed child.

I am grateful to my house surgeon Dr. A. C. Das for the excellent illustrations.

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## A CASE OF ABSENT UTERUS, FALLOPIAN TUBES AND URETHRA

by P. P. CHANDU NAMBIAR, Madras.

A Hindu girl named M. Ratnam, aged 10 years, was admitted under my care in K. G. Hospital, Vizagapatam, on 10-6-48 with a history of constant dribbling of urine since her birth. She has a sister and three brothers who are all well and without any abnormality. Her general condition was good and development normal for her age. But the patient was highly neurotic.

*Physical Examination.*—All other organs are normal.

*Local Examination.*—Vagina appears normal. There is no perineum nor fourchette. Only the sphincter ani externus separates the anus from the vagina. That is to say the posterior angle of the vagina is actually composed of sphincter ani externus. The urine constantly dribbles through the vagina. There is no uterus and consequently no vaginal fornices. The bladder mucous membrane can be seen protruding into the upper part of the vagina. On the lateral wall of the vagina in its upper half there are two openings which at first were thought to be ureters; but on closer examination there was no urine dribbling through them. A number 6 rubber catheter was pushed

through each of them and it went up to a distance of about 2 inches. A ureteric catheter was next tried; but this also went up only to the same distance.

The clinical photograph (Fig. 1) of the vaginal opening shows the small orifices in the lateral vaginal walls. The second photograph (Fig. 2) was taken with catheters inside the openings. On a subsequent date an intravenous pyelogram was taken and it shows the abrupt ending of the ureter below, the dye not filling the bladder (Fig. 3). On a subsequent date India rubber catheters were introduced through the orifices in the vaginal wall, lipidol was injected and X-rays taken (Fig. 4). These show the upper limits of the tubular passages.

*Treatment.*—On 7-7-48 under general anaesthesia the abdomen was opened through a midline sub-umbilical incision and the following were the findings. There was no uterus or Fallopian tubes; the ovaries were found suspended by a fold of peritoneum on either side of the pelvic brim medial to its midpoint. A tubular structure was found running along the pelvic brim on either side; these

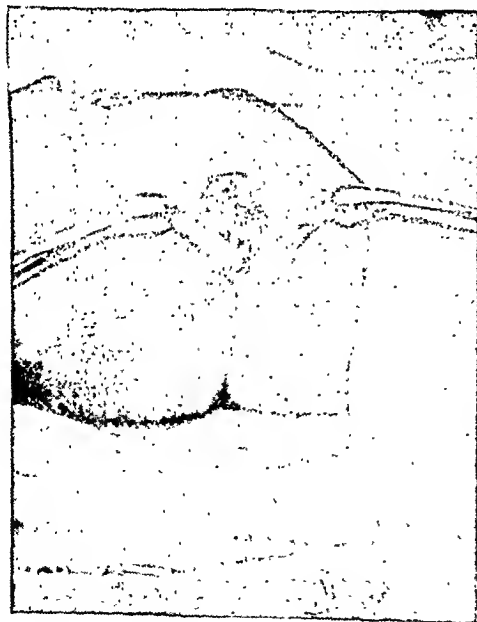


Fig. 1.



Fig. 2.



Fig. 3.

ended in three or four smaller tubules on the lateral aspects of the respective ovaries. A rubber catheter was passed through the openings in the vaginal wall and it passed through the tubular structure described above and ended on the lateral aspect of the ovary. The bladder was normal as viewed from inside the pelvic cavity.



Fig. 5.

**Operation.**—Right ureter was transplanted into the rectosigmoid according to Coffey's method with a catheter pushed into the proximal part of the



Fig. 4.

ureter and brought out through the anal orifice. Pelvic cavity was dusted with sulphonamide powder and the wound closed in layers. Convalescence was stormy. The patient developed a temperature of  $105^{\circ}$  with rigor and pain in the right loin—pyelitis apparently. These, however, were controlled with penicillin and sulphonamide.

On 23-8-48 the abdomen was re-opened through the same incision. Omentum was adherent to the line of the incision. The transplanted ureter was found slightly dilated. The left ureter was exposed and transplanted by the same method and sulphonamide powder was dusted again and the abdomen closed in layers. The convalescence this time was peaceful. There was a rise of temperature next day to  $104^{\circ}$ ; but this dropped to  $100^{\circ}$  the day after and came to normal on the 6th day. An intravenous pyelogram was taken on 4-9-48 (Fig. 5) and this shows dilated pelvis and ureters and the dye collected in the rectum. The patient had put on considerable weight by this time and looked brighter and happier. She was discharged on 10-9-49.

### Discussions

The questions to be considered are why there was this total absence of the uterus, fallopian tubes and urethra; why the bladder wall had not united below and whether the tubular openings are of Mullerian or Wolffian origin. It is therefore necessary to consider the development of these organs. There are two theories current regarding

the development of the vagina. The majority are of opinion that both uterus and vagina are wholly developed from the Mullerian ducts, while others are of opinion that the lower third of the vagina is developed from the Wolffian ducts; there is, however, no conclusive proof for this. Occasionally the Wolffian ducts persist in their entirety—always ending in such cases

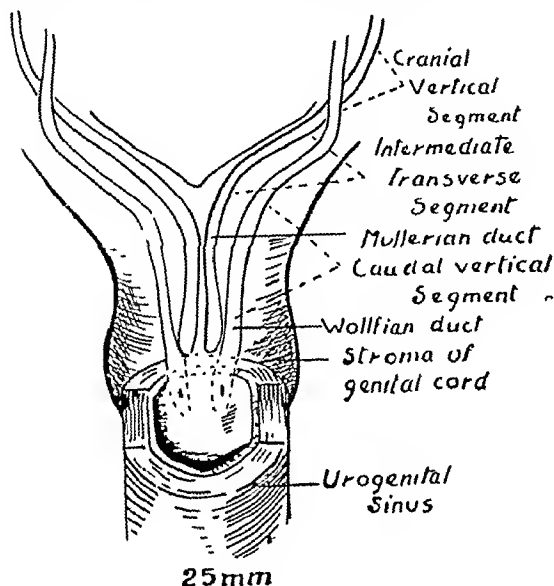


Fig. 6.

caudally in the lower third of the vagina (Figs. 6 & 7). The Mullerian ducts appear at the 11 mm. stage of the embryo. They start as an elongated invagination of coelomic epithelium into the urogenital fold situated lateral to but separate from the cranial portion of the Wolffian ducts. These in adults, remain to become the ostium abdominale of the fallopian tubes. Excepting these cranial ends the remaining parts of the Mullerian ducts fuse and burrow caudally through the mesenchyme of the urogenital fold. The Mullerian ducts, at first lateral and ventral to the Wolffian ducts, subsequently bend towards the caudal extremity of the mesonephros and cross the Wolffian ducts anteriorly and approach in the middle line and extend caudad to the

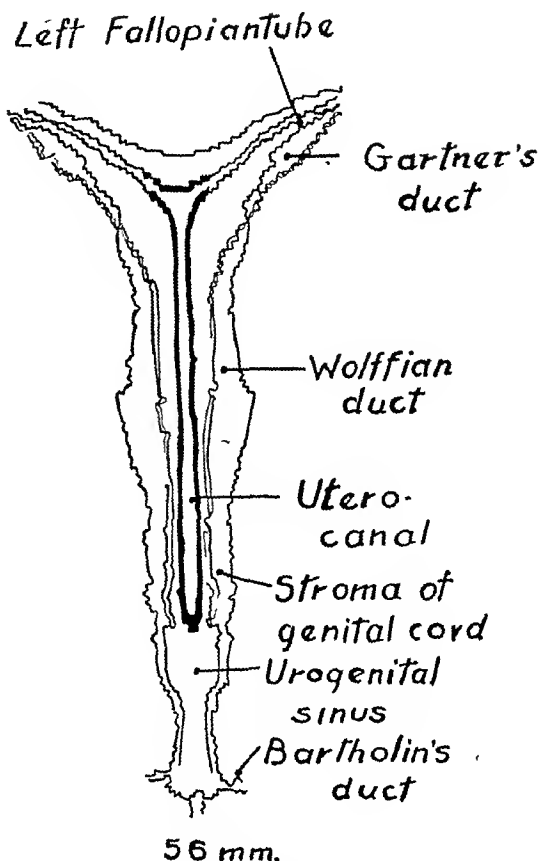


Fig. 7.

posterior wall of the urogenital sinus which is pushed to form a hillock termed the Mullerian tubercle (Fig. 8). As the ducts grow caudally and fuse, a single tube is formed named the uterovaginal canal. The Mullerian system can be divided into three portions, viz. :—

1. A cranial portion—vertical—parallel to the mesonephros and lateral to the Wolffian ducts.
2. Intermediate transverse portion at the level of the caudal end of the mesonephros and round ligament and anterior to the Wolffian ducts.
3. Caudal vertical portion within the pelvis and medial to the Wolffian ducts.



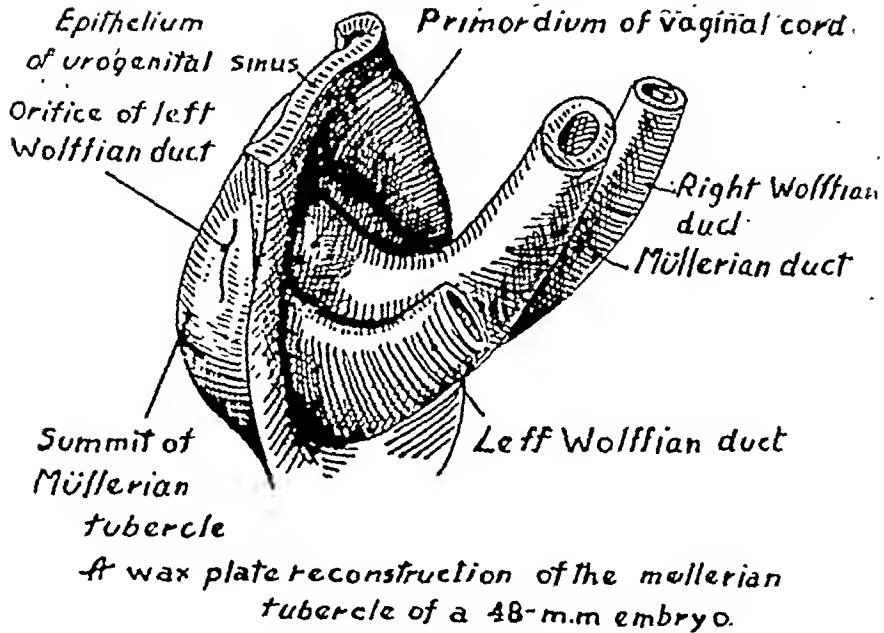


Fig. 8.

The cranial vertical portion becomes the fallopian tubes; the transverse and caudal parts with the surrounding mesoderm form the uterus and upper two-thirds of the vagina.

#### Development of the Vagina

There is no unanimity of opinion regarding the formation of the vagina and hymen. Four theories are in vogue at present. They are:—

1. The vagina and hymen are entirely derived from the Mullerian ducts.
2. The vagina is partly of Mullerian origin—lower third being derived from Wolffian ducts.
3. The vagina and hymen are entirely developed from the urogenital sinus.
4. The vagina is mainly derived from the Mullerian ducts; but the lower end as well as the hymen is formed from the urogenital sinus.

In the 30 mm. embryo the caudal portion of the Mullerian ducts fuse and reach the posterior wall of the urogenital sinus which is pushed forward to form a hillock known

as the Mullerian tubercle (Fig. 9). Between 30 and 56 mm. the growth of the Mullerian ducts occur mainly in a caudal direction. This become the Mullerian portion of the vagina. At 56 mm. the septum between the fused Mullerian ducts disappears and a single though incomplete uterovaginal canal is formed. This septum persists in the marsupials. The Wolffian ducts keep pace with the growth of the Mullerian ducts, but at 56 mm. their openings in the urogenital sinus become obliterated by a plug of degenerating cells and finally disappear. But this does not happen some times and the opening may remain patent. The case reported is probably an instance of this.

The second theory, that the vagina is mainly Mullerian in origin but that a part is formed from the Wolffian ducts, has been advocated by a number of investigators. Tourneut in 1888 and Legay in 1889 presented this theory. According to them the lower ends of the Wolffian ducts take part in the formation of the vagina by fusing with the Mullerian ducts. As evidence it is stated that the Wolffian ducts in bovines empty into the vagina. Beth Retterer 1891 and Spuller in 1930 who have made extensive embryological studies of the develop-

ment of the vagina believe that the lower portion of the vagina is formed from the urogenital sinus. Wharton has reported a case in which both Mullerian ducts were completely missing (absence of uterine tubes, uterus and upper two-thirds of the vagina). But in his case, the lower third of the vagina and external genitalia were normally formed. He states that it is impossible to understand such malformations unless one grants that the upper and lower thirds of the vagina are independent in

their origin and development. So far as the anomaly of the vagina and uterus are concerned this case seems to be a similar one to that of Wharton; in addition there was also the absence of the urethra and the inferior wall of the bladder. It is therefore necessary to consider the development of the bladder and urethra also a little.

In the 11 mm. embryo the urogenital sinus (the ventral portion of cloaca) by elongation and constriction is differentiated into two regions:—a vesico urethral, conti-

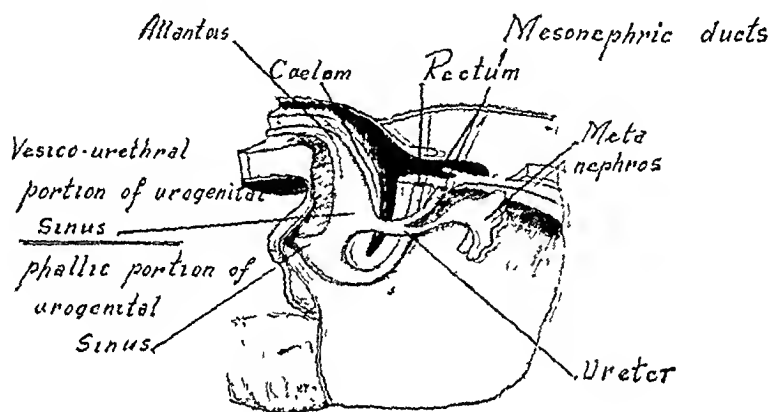


Fig 9.

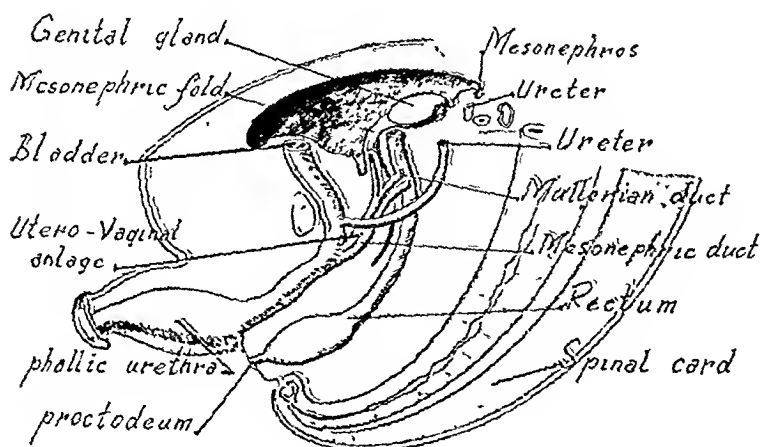


Fig 10.

nuous with the allantois and receiving the mesonephric ducts and ureters and a phallic portion connected by a narrow isthmus with the former and extending into the genital tubercle in both sexes (Figs. 9 & 10). The former division becomes the urinary bladder and more or less of the urethra; the phallic portion develops into the cavernous urethra in the male but becomes merged with vaginal vestibule in the female. Although the bladder and urethra are mainly developed from the vesico-urethral sac there occur certain changes which result in these organs receiving some mesodermal contribution. The trigone and the floor of the proximal segment of the urethra are of mesodermal origin. This mesodermal parts of the bladder and urethra have not developed in this case and that explains the dribbling of the urine. In Wharton's case, sited above, there was no dribbling of urine. This case therefore seems to be unique and is therefore worth recording.

### Summary

A case of absent uterus and fallopian tubes, urethra and the inferior wall of the bladder is described.

Developmental processes which may lead to these defects are described.

The operative treatment adopted to relieve the dribbling is described.

I have to thank Dr. M. V. Ramana Murthy, Superintendent, K. G. Hospital, Vizagapatam for kindly permitting me to report this case. Dr. Bhadriah the Radiologist who took the clinical and radiological photographs and Dr. K. Narayanan Nair, Curator in Pathology, Stanley Medical College who drew for me the pictures from "Obstetrics and Gynaecology" by Arthur H. Curtis, Vol. I, 1937 edition.

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## CASES & COMMENTS

### A CASE OF BRONCHO-BILIARY FISTULA

by N. S. NARASIMHAN, Madras.

Cases of broncho-biliary fistula are of rare occurrence and this is enough to justify the publication of every case observed.

Kandaswami, male, aged thirteen, Hindu, native of Madras, was admitted into the medical wards of the Madras General Hospital on 30-11-1944; weight of patient 46 lbs. He was admitted for cough and fever with expectoration; the cough was constant and persistent; the expectoration was thick, not-foul smelling and was purulent. Rales could be heard all over the lungs. No other abnormality was detected. Sputum examined by all methods did not show tubercle bacilli.

10-12-1944. Screening—diaphragm moves freely with respiration; mediastinal glands enlarged on left side. Plain x-ray showed no sign of pulmonary tuberculosis or lung abscess. Lipiodol bronchography showed the appearance of a cyst in rt. mid. zone.

15-12-1944. Serum proteins—Albumin 2.29%—Globulin 3.763%. Total proteins 6.053%.

Differential count: P. 85, L 9; M 4; E 2.

19-1-1945. Total W.B.C. 9800.

Sputum was tinged yellow and showed the presence of bile. Patient complained of pain in the liver area.

25-1-1945. Van-den-bergh test both direct and indirect was negative; jeteric index was 2.2; blood showed polymorpho-nuclear leucocytosis; there were attacks of fever, cough and expectoration of bile with enlargement of liver. The attacks used to come once in 15 days. The amount of bile coughed out varied from ten oz. on some days to almost nothing on other days.

Urine.—There was no bile pigment or salts. Faeces were bile-stained and there were no amoebae or cysts; "Shādoel" pictures taken twice did not reveal any fistulous communication between the liver and lungs. Patient was transferred to the surgical side on 11th Feb. 1945. On 14-2-45 on screening the diaphragm moved normally.

On 26-2-45, after adequate preparation with blood transfusion he was operated on under local nerve block and gas and oxygen. The anterior and superior aspects of the left lobe of the liver were free; there were filmy adhesions between the superior surface of the right lobe and the diaphragm. The lesser curvature of the stomach was completely adherent to the liver; structures in the epiploic foramen could not be identified.

The gall bladder was shrunken and contained one pigment stone and this was removed; the common bile duct and the right hepatic duct were ultimately identified and the former opened into; two stones were removed and the duct was drained; Morrison's pouch was drained. The blood pressure after operation was 60/55 and the pulse 140 per minute. In spite of resuscitation measures patient could not be rallied and expired on the same day 8 hours after operation.

Even a partial autopsy could not be obtained and so a fistula from the bile duct through the diaphragm into the lung could not be traced. There was no previous history of jaundice or any serious illness. Bronchoscopic examination was not successful.

Moynihan in his book on abdominal operations, Vol. II, P. 408 refers to 'fistulae between the bile passages and the urinary tract and the lungs. Grey Turner in Choyce's system of surgery makes reference to internal biliary fistulae which are probably commoner than external but remain unrecognised owing frequently to lack of symptoms. Fistulae between the gall bladder and the stomach, duodenum, colon kidney, lung or even the bladder and pregnant uterus are described. Walton in his text book of surgical dyspepsias says "occasionally there may be a communication with the thoracic viscera. Naunyn collected ten such cases and Cui voisier twenty four; two cases successfully treated by operation have been recorded by Sir High Rigby and Sir Mayo Robson. It is probable that in these cases the communication is made through a subphrenic or hepatic abscess which has perforated the diaphragm." Burgess (Manchester) has described in detail a case which is highly instructive and has given a summary of other cases in the literature

His was a female patient aged 59 with no obvious previous history of illness coughing up ten to twenty oz. of bile; there were no abnormal physical signs in the abdomen, even on four radiographic examinations. Exploratory laparotomy was performed;

a contracted thick walled gall bladder with calculi and a dilated common bile duct were found. There were no adhesions about the upper surface of the right lobe of the liver but the left lobe was adherent to the surface of the diaphragm. There was a calcified swelling adherent to the extremity of liver, lesser curvature and spleen behind. This was cut out with the knife and biliary mud escaped. The common bile duct was opened into and a dozen stones removed. The patient had an uneventful recovery. The most probable sequence of events had been—gall stones in the gall bladder and common duct, suppurative cholangitis and perforation of left hepatic duct, formation of a small subphrenic abscess between the extremity of the left lobe of the liver, diaphragm, spleen and lesser curvature of the stomach, adhesion of the left lung to the upper surface of the diaphragm and subsequent perforation of the abscess.

Courvoisier collected in 1890 twenty four cases of broncho-biliary fistula of which six were seen during life and recovered and eighteen at autopsy. In 1897 Grahagam collected eleven further cases. In 1912 Yasuda collected in all 49 cases including one of his own. Two more cases have been recorded upto 1922.

Of these, 46 cases came to autopsy and six were alive. Of the 46 cases, 25 were due to cholelithiasis, 10 to echinococcus cysts due to infestation of liver as a result of intra-duct rupture, 5 to abscess of the liver, 2 due to amoebic dysentery and 2 due to ascariasis of the biliary passages and 2 to trauma.

Laceration of the diaphragm is essential in the injury cases. No case is reported of primary lung disease leading to a broncho-biliary fistula. J. Douglas Miller (Sydney) records a case of broncho-biliary fistula resulting from injury of the common-bile duct after a cholecystectomy in a male aged 50. Five months later the patient developed deep jaundice; he felt great relief when he coughed up a large quantity of bile. Lipiodol into the trachea failed to show the fistula. At the autopsy there was cicatricial obliteration of the hepatic duct at the porta hepatis; proximal to this the ducts were enormously dilated; a small track lead from one of these dilated ducts to the upper surface of the liver and then through the diaphragm into the lung.

In India some cases of tropical liver abscess terminate favourably by bursting into a bronchus and eventually clear up.

Broncho-biliary fistula from other causes would require early operative treatment judging from the large number of cases that were seen at autopsy.

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## A CASE OF QUADRICEPSPLASTY

by N. S. NARASIMHAN, Madras.

This case is presented for the reason that this was the only procedure which provided a solution in the treatment of the following case.

A female child aged three was brought in July, 1947 for stiffness of the right knee joint; there was a scar one and half inches long in the middle of the front of the right thigh. The scar was due to a healed abscess operated on in another hospital. After the healing of the abscess the child could not bend the knee; the quadriceps was acting and the patella was mobile; x-rays of the femur and the knee joint were normal. The child was examined under an anaesthetic but no movement of the knee was possible. After quadriceps exercises and diathermy further examinations under an anaesthetic on three different occasions did not produce any movement in the knee joint. Then I came across the operation of quadricepsplasty by Col. Thompson in the *Journal of Bone and Joint Surgery*.

The essential principles and the technique are as follows:—

"A full range of knee motion requires a considerable excursion of the patella to which all the components of the quadriceps muscle are attached. Scarring, fibrosis or loss of extensibility of any one of the three deeper parts of the quadriceps will firmly anchor the patella to the femur definitely restricting knee motion.

In each of the cases it has been found that the vastus intermedius had been partially or completely replaced by a tough mass of scar tissue which effectively limited flexion.

The rectus femoris differs from the other components of the quadriceps in that it is considerably longer: it spans two joints, so that flexion of the hip relaxes it and allows freer flexion of the knee. The nerve and blood supply enter the posterior surface of the muscle in the upper third of the thigh.

The degree of success to be expected in quadricepsplasty depends entirely upon whether or not the rectus femoris has escaped injury, how well it can be isolated from the scarred non-extensible parts of the quadriceps mechanism, and how well it can be developed by intensive exercise and normal use.

It is the rectus femoris that normally provides the last 10° of active extension of the knee and it is the preservation of this muscle without lengthening it that allows early motion and seems to be responsible for the rapid return of active extension.

*Operative technique.*—Anterior skin incision is made from the upper 3rd of the thigh to the lower border of the patella. The fascia is divided on either side of the rectus femoris distally from the upper third of the thigh, where the muscle is almost always normal. This muscle is then dissected free of, and drawn aside from, the vasti. The vastus medialis is freed and allowed to fall to the medial side and the vastus lateralis to the outer side. The capsule is divided on either side of the patella, the incisions extending distally on both sides so that the contracture of the capsule is overcome. The vastus intermedius may be a mass of scar tissue firmly attaching the under surface of the rectus femoris and the patella to the anterior surface of the femur. This is excised completely leaving a fibrous and periosteal covering over the front of the femur. If the rectus is embedded in scar tissue a new rectus is made.

At this point it is possible to manipulate the knee to an angle of about 70°, i.e. well beyond a rt. angle. The remaining intra-articular adhesions give way. The upper normal part of the rectus femoris will stretch out readily, and there is no danger of fracturing the patella.

If the vastus medialis or lateralis is fairly normal, it is sutured to the side of the rectus femoris down to the junction of the middle and lower third of the thigh. No attempt is made to close the knee capsule; if the muscles are badly scarred they are not sutured back to the rectus femoris. In these cases where there are old healed sinuses and multiple incisions in either the vastus medius or lateralis, the subcutaneous tissue and fat are brought down and sutured to the femur on one side or other of the rectus, in order to produce a new inter-muscular septum and eliminate all the scarred muscle from the remaining quadriceps mechanism.

Skin is closed and the extremity placed in a Thomas splint with a Pearson attachment to allow early motion.

Passive and active motions are begun immediately in balanced suspension. Recovery is surprisingly rapid. This procedure

has been followed for loss of knee function after compound fracture, etc."

In the operative procedure that was adopted in this child, the vastus intermedius was found scarred and even after excising this, I could not bring about an improvement in the movement of the knee joint until the scar tissue on the lateral and superior aspects of the patella was excised when I could get full range of movement. This anchoring of the patella by the thick scar tissue at the superior and lateral portions of the patella to the condyles of the femur was stressed by Johnson.

The operation was done in June; there is 40° of flexion range at present and the child could squat for meals. This is my first case; the procedure seems to be sound: I had to leave several cases as hopeless before.

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## A CASE OF CARCINOMA OF THE GALL BLADDER

by N. S. NARASIMHAN, Madras.

Cases of Carcinoma of the gall bladder though not rare are uncommon.

Patient Kondiah, aged 45 years, was admitted on 7th June 1946, for fever and swelling in the abdomen of 3 months' duration.

There was no previous history of amoebic dysentery. He remembers to have had an attack of malaria six years ago. Otherwise he had till recently no bodily ailment.

His complaint started three months ago with fever. After a week he noticed a small lump in the right hypochondrium. There was no diarrhoea or dysentery. Micturition and defaecation normal. No history of vomiting was elicited. Swelling had increased to present size within 2 months. Then there was no further increase in size. Since a fortnight he had vomiting thrice a week. No haemetemesis or melaena was present. Fever had been continuous since ten days. There was no loss of appetite.

On examination, patient looked toxic; temp. 101.4 F. Pulse 100/min.; volume and tension good. No arteriosclerosis; not jaundiced; not cyanosed; anaemic; tongue coated.

Local Examination—Abdomen moved freely with respiration. There was a swelling in the rt. hypochondrium and lumbar regions moving with respiration. On palpation, a fairly spherical firm mass about the size of a tennis ball was found in continuity with the liver. Mass not cystic. The hand could be pushed below the costal margin and apparently swelling looked continuous with the liver. Rt. loin was not prominent. Mass could be moved freely in transverse and vertical directions. Mass was not tender but painful on deep pressure. There were no palpable glands. Spleen was not enlarged. No free fluid in the abdomen. No visible peristalsis. Both testes were normal. Other systems—nil abnormal. Rectal examination—nil abnormal.

Other investigations done.—B.P. 110/70. Urine—No albumin or sugar; no bile salts or bile pigments, no R.B.C.s or casts.

Flam x-ray abdomen.—No calculus; dense shadow of the swelling mingled with intestinal shadow.

Faeces—Normal coloured; solid; no blood or mucus. Microscopic Examination—Nil.

Urine culture.—Sterile.

Blood for W.R. and Khan.—Negative.

Barium meal.—Gastrointestinal tract was normal.

Blood W.B.C. 9200/Cmm.; Hb %.

Blood smear: No M.P.

Diff. counts.	Polymorphs	73%
	Lymphocytes	23%
	Eosinophils	1%
	Monocytes	3%

Blood urea: 27 mgm.

During the week in which the above investigations were being done patient had only 100 to 101° temp. and was given empirically five emetine injections and "Cibazol" tablets, 4 grms. daily for six days. But the swelling did not show any change. Patient had no other complaint except constant pain on the swelling, and fever. In the absence of jaundice or colic, the case was thought to be one of amoebic abscess of the liver, and operation was decided upon. On 15th June under local and gas and oxygen, a rt. subcostal incision 6" long was made. On opening the peritoneum, the swelling was found to be continuous with the liver, fluctuating at places and smooth on the surface. The liver was smooth; there was no umbilication; the swelling was walled off by two gauze packs to avoid peritoneal contamination. The swelling was explored and chocolate coloured pus aspirated. It was drained. The pus, on culture, was sterile and the smear did not reveal amoebae or cysts but only R.B.C.s and a few pus cells. On the 19th, the drainage tube was changed; a smear taken from the wall of the track did not reveal amoebae or cysts. Post-operatively emetine injections were continued. Patient said he had less pain and the temperature had touched normal for 2 days; the discharge continued. During a further period of a fortnight he had no fever and had only backache. All of a sudden, patient became toxic on the night of 6th July 1946, had 104° temperature. The blood smear did not reveal malarial parasites. Next morning he expired. As emetine and drainage had not improved the condition of the patient and as no clinical evidence of other disease had been observed, an autopsy was done.

15th July 1946. Autopsy notes.—A small cocoanut sized whitish tumour adherent to and continuous with the liver was seen. There was no surface irregularity and the tumour was thought to be a hepatoma of the liver. The mass could be separated from neighbouring viscera with difficulty. Tumour was friable and extended to the under surface of the liver. No gall bladder could be seen.



on removing en masse the tumour and the liver; a search in the line of the tumour towards the porta-hepatis, revealed stones at the neck of the tumour; these stones, on opening were confirmed to be gall stones. The tumour was from the fundus of the gall bladder. The central portions of tumour had undergone necrosis. Porta hepatis group of glands were hard and enlarged. No secondaries in the liver or other viscera were noticed. Peritoneum was free of secondaries. Other additional findings were (i) no jaundice; (ii) free bile found in duodenum and no obstruction to common bile duct; (iii) spleen not enlarged.

Histological examination of the friable portion of tumour showed adenocarcinoma and the portion from the junction of neck and gall bladder to be epidermoid carcinoma. Naked eye examination of specimen:—liver not enlarged; tumour mass was of 5" thickness by 4" width; the growth did not extend into the substance of the liver. Early metastasis into the liver is said to be a common feature of carcinoma of gall bladder.

#### POINTS OF INTEREST

1. Rapidly growing swelling of three months' duration in a male aged 45, diagnosed as amoebic abscess.

2. On operation, chocolate coloured fluid mistaken to be due to amoebic infection.

3. Patient throughout without jaundice or colicky pain; sudden death with hyperpyrexia.

4. Post-mortem, mass first appeared to be hepatoma liver, and on further search identified as cancer of the gall bladder in association with gall stones. Further the common bile duct was patent.

#### Remarks

Adenocarcinoma of the gall bladder is rare in males. This tumour can be easily mistaken for amoebic infection of liver in the Tropics. Gall stone as the aetiological factor of carcinoma is evident from the case. The chocolate coloured pus and smooth liver surface added to the difficulties of diagnosis. It is always necessary to avoid peritoneal infection with amoeba in treatment of amoebic liver abscess and hence a more thorough search was impossible. Naturally chocolate coloured fluid was from necrosis and haemorrhage in the carcinomatous mass.

#### Discussion

Early diagnosis of carcinoma of the gall bladder is essential to get '5 years or more' cure. Carcinoma is a disease more common in women between 4th and 5th decades as in them there is a preponderance of cholelithiasis. Wadheim and his associates state that in 33,500 operations on the biliary tract at Mayo clinic from 1907 to 1940, 291 cases were of primary carcinoma of the gall bladder, i.e., 0.87% incidence. An analysis of early symptoms revealed nothing which could not be attributed to the presence of chronic inflammation in the gall bladder. Cholelithiasis and metaplasia was found to be the origin of squamous cell carcinoma. In non-advanced cases, no definite diagnosis was made pre-operatively. Jack and Donald in 1940 reviewed the clinical symptoms from 55 cases (21 males and 34 females) as

(1) Chronic, recurrent dull pain in rt. hypochondrium.

(2) Jaundice in 61% of cases of which 5% developed jaundice only as terminal event.

(3) Gastro-intestinal symptoms of dyspepsia, anorexia, nausea or vomiting.

(4) Cachexia in 31 cases.

(5) Palpable mass 12 cases.

(6) Oedema and ascites in 40% of cases.

(7) Duration of symptoms may be from 2 to 5 months.

#### Conclusion

Carcinoma of the Gall bladder is yet another condition for the surgeon in the Tropics, to successfully diagnose and rule out as a possibility, when he treats innumerable cases of amoebic liver abscesses.

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## REVIEWS OF BOOKS

**The Surgery of Abdominal Hernia** by George B. Mair. Edward Arnold & Co., London, 1948. No. of Pages: 408. No. of Illustrations: 138.

This excellent monograph on Abdominal Hernia gives a very comprehensive account of all varieties of abdominal hernia with special attention devoted to the problems of inguinal hernia. The subject is of great interest to all surgeons who, whatever their particular method, will have a variable number of failures, to their account. The author's approach is essentially rational and based upon anatomical and functional considerations. The author's account of the "whole thickness skin graft technique" is so complete and so rational that many surgeons would be tempted to use it, in selected cases. The author's arguments in favour of or against any particular method are essentially sound and based upon statistics and published literature. We feel that this book will go a long way towards introducing some clarity of thought in the treatment of a condition where, if one were to judge from the multiplicity of methods suggested by different people at different times, there has been general dissatisfaction with the results.

C. P. V. M.

count of this latest addition to the surgery of peptic ulcer. The book should find a place in the library of every surgeon interested in abdominal surgery and will be found to be particularly useful to the post-graduate student of surgery.

C. P. V. M.

**Textbook of Surgical Treatment including Operative Surgery.** Edited by C. F. W. Illingworth.

The third Edition of this valuable book, first published in 1943, has incorporated advances in Surgery during the past three years. The book is of a very great value to those who are entering the specialised practice of surgery, and will be greatly appreciated by the senior student of surgery. The book is well got up and well illustrated.

C. P. V. M.

**O'Meara's Medical Guide for India and the Tropics** by H. W. Williamson. M/s. Butterworth & Co. (Publishers), Ltd., London, 1947. Fifth Edition—No. of Pages: 882. No. of Illustrations: 35.

As we read through this book, we get an impression that the material presented is probably for the Medical Practitioner in out of the way parts of India. If that is so, we must confess that there are several chapters in which the information given as regards the diagnosis and treatment is not quite adequate. Too few details are given about common every day occurrences, whereas too much emphasis has been laid on the treatment of conditions that are difficult to tackle in an inadequately equipped and remote place. To quote a few examples, the sections dealing with the diagnosis of acute appendicitis, the diagnosis and treatment of backache, the management of gangrene, enuresis in children, causation and treatment of epididymo-orchitis are not quite satisfactorily dealt with. On the other hand, too much space is taken up by details of the technique of bronchoscopy, oesophagoscopy, treatment of ruptured bladder, brain abscess, etc. We wish that certain statements like "bronchiectasis is not common in India", "diagnosis (of vesical calculus) is made by the bladder sound", "in India this (cirrhosis of liver) is nearly always the result of chronic malaria", "this (blood transfusion) is best done through a funnel and tube" are suitably rectified in the next edition. We also feel that more diagrams should be included so as to make the text easily understandable and applicable.

**The Surgery of the Stomach and Duodenum** by T. H. Somervell. Edward Arnold & Co., London. No. of Pages: 546. No. of Illustrations: 231.

This book from the pen of a surgeon who has had a long and unique experience of this branch of surgery in Southern India is a welcome addition to the already voluminous literature on the surgery of the stomach and duodenum. The subject has been dealt with exhaustively and is written in a clear and lucid style with considerable attention to detail. Besides being a valuable record of the author's own experience, the book contains the substance of the methods and results of other workers in this field. Special attention may be drawn to the excellent account (hitherto unpublished) of the extrapleural transdiaphragmatic gastrectomy as performed by Mr. Gardham of London. The book is properly illustrated and the line drawings, made by the author himself, are of a very high quality. While one cannot share the author's enthusiasm for the operation of devascularisation of the stomach, the methods advocated, generally speaking, are sound and the author's evaluation of various operative measures will meet with general approval. The chapter on vagotomy contributed by Mr. I. M. Orr of the British Post-graduate Medical School is a fairly complete ac-

However, these general criticisms do not in any way detract from the general value of the book. It contains a variety of information, "which ranges from how to deal with a transverse presentation to how much castor oil to give an elephant." In this edition, several sections on chemotherapy, fractures and dislocations, infections of the hand, anaesthetics and vitamins, etc., have been added or re-written. The articles on D.D.T., dental surgery, diet, eye diseases, medico-legal and lunacy are some of the very useful and fairly exhaustive articles. The contents of the whole book are arranged in an alphabetical order. We are sure that many will be benefitted by the large amount of information that has been compressed into a work of this size.

U. M. R.

**The Principles and Practice of Rectal Surgery** by W. B. Gabriel. H. K. Lewis & Co., Ltd., London, 1948. No. of Pages: 508. No. of Illustrations: 289.

This book is so well-known and is so widely used that little needs to be said concerning the general content of the Volume.

In this, the 4th Edition (1948), a very careful revision of the text has been made. A detailed chapter profusely illustrated has been added on the anatomy, the causation, the diagnosis and treatment of anal incontinence. The sections on general conditions, as they affect the rectum and their treatment have been suitably modified. In the chapter on malignant disease, the figures, tables and references have been brought up-to-date; in addition to these, several very useful sections dealing with biopsy, differential diagnosis of cancer of the rectum, resection of hepatic secondaries, the restorative resection of rectum for cancer, radical combined excision of rectum for carcinoma of the anal canal, have been added.

The author's aim to present "within a reasonable compass a complete account of rectal surgery with particular care...to recent...work in this branch of surgery" has been ably achieved.

U. M. R.

**Surgical Urology (Vols. I & II)** by Dr. G. De Illyes. Constable & Co., Ltd., London W.C. 2, 1942. No. of Pages: 679. No. of Illustrations: 391.

These two volumes from Dr. G. De Illyes, the well-known urologist from Budapest, are a welcome addition to the existing literature on this speciality. In Vol. I the author deals with the symptomatology, the methods of examination and with the diseases of the kidneys and ureters. In

Vol. II, the disorders of the rest of the genito-urinary system are dealt with.

The methods of examination and therapy detailed are those that have been found most suitable at the Clinic of Urology of the University of Budapest. In addition to a wealth of information on these and on clinical symptoms, the book is profusely illustrated, several of them partly coloured. At the end of each chapter, useful statistics from the Clinic are presented and there are several excellent reports of cases of special interest.

As the book was set up by Hungarian craftsman and was printed in 1942 (though it was released only in 1947), some inevitable errors in terminology and grammatical construction have resulted. A few diagrams have been wrongly referred to in the text. There is very scant reference to the sulphonamide group of drugs and no reference at all to the anti-biotics. The "chemotherapy" of malignant prostate, the place of irradiation in penile carcinoma, endocrines and surgery in the management of undescended testes, technical details of operative procedures—these are some subjects that have not been adequately dealt with. Rectification of these few defects (if we may call them so) will very definitely enhance the value of this splendid work, written from extensive personal experience, beautifully illustrated and enriched by the description of so many individual cases. We are confident that this book will be very useful to the urologist, the surgeon and the senior student.

U. M. R.

**A Surgeon's Guide to Local Anaesthesia and a Manual of Shockless Surgery** by Corlette. John Wright & Sons, Ltd., Bristol, 1948. No. of Pages: 355. No. of Illustrations: 200.

This is an excellent monograph on the subject written by a surgeon for the benefit of surgeons. It is unique in that it records the practice of what one has preached for over a decade and bears the stamp of individuality and authority that is natural from a varied and rich experience in anaesthesia and surgery combined.

In his search for a safe and shockless anaesthesia technique, he finds a haven in local analgesia—a simple and yet an unfailing and unrivalled ideal. The author overshoots the mark when he refers to general anaesthesia. His misconceptions with regard to general anaesthesia merit correction. General anaesthesia has made advances and kept pace with surgery. The terrors of ether and chloroform no longer exist. Local and general have each to play a worthy role. Neither of these can supplant the other. On the other hand it is the combination of the two that

approaches the ideal of the anoci-association of Crile. In the discussion of the various methods of local analgesia, the author does not hide his strong prejudice against such techniques as spinal, caudal, posterior splanchnic block of Kappis, paravertebral blocks, etc. These are regarded as dangerous as, if not more so than, chloroform anaesthesia. One should not forget that every general rule has an exception and that generalisation cannot be based on exceptions. Selection of the cases, scrupulous attention to details and mastery of technique make for safety irrespective of its being a local or a general.

Great emphasis is laid on premedication, use of adrenalin in proper dilutions along with iso-tonic analgesic solutions and correct postural set ups for the patients. Another striking feature of the book is the detailed description of the surgical anatomy of the various regions with particular reference to nerves and arteries. A bloodless field or as the author would like to term—a "physiological tourniquet" is secured by employing adrenalin with isotonic novocain solution, in dilutions of 1 in 200,000, 1 in 100,000 and 1 in 75,000 along blood vessels—capillaries, arterioles, etc. Even in thyrotoxicosis adrenalin 1 in 400,000 has been used without regrets.

The mainstay in regard to pre-medication has been the use of morphia and hyoscine in two doses—the first one given two hours and the second one given one hour before the induction of local. A scheme of dosage according to age is drawn up. A

chapter is devoted to the preparation of solutions, sterilisation, needles and syringe used. This is certainly a great boon to those who are likely to miss things in the hurry of the moment. The section on pain sensitiveness of different parts is also of great value.

On the subject of methods of local analgesia the writer considers infiltration technique superior to nerve-blocks in fulfilling a dual purpose of analgesia and ischaemia of the blood vessels of the region concerned. When nerve-blocks are preferred solely for the sake of analgesia, it is supplemented by infiltration to bring about what the former fails to do, a bloodless field. Cross-section blocks of extremities and criss-cross or the latticing injection methods are described in detail. Great stress is laid on the vertical suspension of the lower extremities to the ceiling by block and pulley arrangement for amputations in order to save blood which would otherwise be lost from the patient and to obviate the necessity for the tourniquet and retractors to clear the field of the muscles.

It must be recognised, however, that local analgesia techniques, including infiltration, the great favourite of the author, is not an unmixed blessing in the hands of a novice. They make great demands on the operator's time and patience. Local anaesthesia like general anaesthesia needs initiation and an exacting period of probation on the part of its votaries. There are no shortcuts.

D. H. R.

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### Proceedings of the X Annual Conference of the Association of Surgeons of India

The X Annual Conference of the Association of Surgeons of India was held on the 30th and 31st of December, 1948 and the 1st of January, 1949, at the Prince of Wales Medical College, Patna. More than 60 members from various parts of India were present.

Dr. S. R. Joglekar of Bombay, President of the Association, presided over the deliberations and Dr. U. P. Sinha was the Local Secretary.

30-12-1948

The Inauguration of the Conference by H. E. Sri M. S. Aney, Governor of Bihar, took place on the 30th of December at 9-30 A.M. at the Wheeler Senate Hall.

Before the Function started, Dr. U. P. Sinha read out a message from Dr. Rajendra Prasad as follows:—"Wish Conference all success. Trust its deliberations will be fruitful and help relieve human suffering".

In his inaugural address Sri M. S. Aney, after welcoming the delegates to the ancient city of Patna or Pataliputra, made a touching reference to the death of Sir Akbar Hydari. "This chain of sorrowful thoughts leads me inevitably and imperceptibly to the great loss which the new Indian Union has suffered by the death of Mahatma Gandhi. Although he (Gandhiji) was a follower of naturopathy, he had known by experience how indispensable to mitigation of human misery the science and art of Surgery was. He used to speak in terms of highest praise of the Surgeon who had operated on him for appendicitis. India will ever remember with gratitude this Surgeon who thus saved him for the further service of his Motherland. Along with the non-violent weapon in the armoury of Mahatma Gandhi, the Surgeon's knife can rightly claim to share the credit for the Victory of freedom's fight."

Continuing His Excellency remarked: "The problem with which you have to deal are bound to be those in which the interest of the classes and the masses are most vitally and equally concerned....That all are equal in the eyes of diseases and death is a universal proposition....Never does a person feel his equality with the rest of humanity more keenly than when he is suffering from a disease and is lying prostrate and helpless on his bed....He sees that the knife of the Surgeon cures the disease irrespective of the caste, class or creed of the patient. There is no communalism in the Science and Art of Medicine. It is essentially humanitarian. All those who are practising this profession of giving relief to those who suffer from ailments and diseases are certainly advancing the cause of humanitarianism...."

After making very brief references to the well developed state of the Science and Art of Medicine in Mythological and Ancient India, the Governor of Bihar said: "it will be interesting for the members of the Conference to know what Fa-Hian, the famous Chinese traveller, says of the state of Medical relief in the ancient city of Pataliputra":

"The cities and towns of this country are the greatest of all in the middle kingdom. The inhabitants are rich and prosperous, and vie with each other in the practice of benevolence and righteousness. The heads of the Vaishya families in it have established in the City, houses for dispensing charity and medicines. All the poor and destitute in the country, orphans and widows, childless men,

maimed people and cripples, and all who are diseased, go to those and are provided with every kind of help, and doctors examine their diseases. They get the food and the medicines their cases require, and are made to feel at ease, and when they are better, they go away of themselves."

After referring to the "extraordinarily rapid wonderful and many-sided advances" that Surgery has made during the War, His Excellency stated, "I am sure that the distinguished Surgeons assembled here will carefully deliberate and devise means for making all this valuable knowledge available to the students studying Medicine in Indian Universities, and also suggest methods to bring the latest remedies within the easy reach of the sufferers living not only in cities and towns but in the distant villages of the country."

"In the age of democracy, we speak very often of equal opportunities to all. I will like to add to it equal remedies to all for relief from diseases also. It is important to establish institutions that shall give the best and the most effective relief to the poorest of the poor along with the richest of the rich. The State, the Scientists, and the practising Experts must think over the means to make the latest scientific remedies for cure of diseases available to the patients suffering in the thatched cottages of the Indian villages and not merely to Princes living in Palaces. I hope that a day will come soon when all these inequalities will disappear, and an era of equality of Medical treatment to all will be established."

"I look upon the Surgeons assembled here as the vanguards of the army of social workers and of servants of humanity who are fighting patiently against privileges and prejudices to usher in the dawn of this golden age of equality."

Dr. T. N. Banerji, Chairman of the Reception Committee, then welcomed the Surgeons to "Pataliputra or Patalibothra of Megasthenes". In his speech he commented upon the remarkable advances and achievements of modern surgery with its efficient anaesthetic and adequate resuscitative and chemotherapeutic aids. "The other important factor on which the success of our Surgeons depends, is the post-operative nursing care which the patients receive. Unfortunately there is an acute dearth of trained Nurses in our country." Concluding he requested the guests to pay a visit to the "historical relics of the once famous University of Nalanda where students from outside India used to come and learn the wisdom from the sages of Magadha. There was in Nalanda\* a residential University, housing ten thousand students

and an adequate number of teachers at a time when the rest of the World was steeped in darkness, ignorance and illiteracy."

Then Dr. S. R. Joglekar delivered his Presidential address:

## PRESIDENTIAL ADDRESS

by S. R. JOGLEKAR

I am thankful and grateful to the members of our Association for electing me President this year, the highest honour a Surgeon in our country can aspire to. I feel great pride and not a little embarrassment in speaking before you to-day. The reasons for this are not far to seek. I am fully conscious of my short-comings, and it will be difficult, well nigh impossible to attain the heights of eminence of my predecessors in Office. Still I am going to try my best and in this connection, I recall the words at another well known occasion when the person accepting the high position he was elected to, said to his electors. "It makes a man humble to be chosen so, so humble that no man but would say no to such bidding if he dare."

This is our tenth year of existence—our Iron or Copper Jubilee—and to compare ourselves to the ordinary human child, we have become somewhat self reliant, but not entirely so. Just as a child of this age has to depend on its parents, we have still to depend on the help we should get from Governments, Universities and the general public. We have, so to say, left the Primary-School and entered a Secondary School; but are still far from higher or University education. Although we have passed the period of the highest infant mortality and are more or less certain of our sturdy physical health, our mental or psychological outlook has still to be built up and the next few years are going to be a little testing for us in that direction.

A child of this age very often begins thinking for himself and starts to form plans for his future. Obviously these thoughts require mature guidance. The guide has to allow more and more freedom and self reliance, but only that much which is safe.

My predecessor in office, talked to us about certain aspects of medicine in general and surgery in particular, tracing its history in brief and emphasizing certain general principles. He mentioned many things in which our Governments and authorities can and should help us. I propose to-day to say a few words mostly about things we can do ourselves without relying too much on outside help—in other words, like the example of a child, to begin to think for oneself and outline a plan for our future course and career. What I shall say about the future should not be understood as the ideal plan. My chief idea is to start thoughts and discussion about it—set the ball rolling—and you the fellow members are at perfect liberty, in the words of our rules and regulations, to alter,

\*Thanks to the excellent arrangements made by the Reception Committee, several members had the inspiring and proud experience of visiting this ancient seat of learning, as well as nearby Rajgyr with its hot springs.

amend, add or delete anything from my suggestions.

Surgery to-day is a very important subject to Society as a whole and specially so in a country like ours where even ordinary surgical help is not available to the vast majority of our people, far less advanced or specialised surgery as practised in America, Russia and some other advanced European countries. Consequently, the chief problem before us is not so much the study of surgery, pure and simple, but that of training the future surgeons. The problem is two-fold, the training of general surgeons and the training of specialists in the various branches of surgery and research workers. Although we should try to advance both these classes simultaneously, I am of opinion that for the next few years at any rate, greater emphasis should be laid on the general surgeons or to quote another famous saying, "First thing should come first." If we train good and efficient general surgeons, I am sure specialists in branches of surgery and research workers will train themselves and evolve from amongst the general surgeons. Therefore my remarks will mostly apply to general surgery.

The training of a surgeon, should in theory start as early as possible in childhood like the Jesuit practice of "catching them young." The undergraduate training in the basic sciences and the fundamental principles in the art and science of "Medicine" as a whole is a problem of primary importance. The elaboration of this point, however, will make this address too long and is sure to tax your patience. I shall therefore restrict myself to mentioning only the basic principles in undergraduate training and a little more detailed discussion of the following heads:—

1. Training of postgraduates and young surgeons.
2. The full fledged surgeons and teachers and their duties towards themselves and the general public.
3. Surgical research.
4. Profession of surgery as a whole.

To speak generally about undergraduate training, as I said above, it is necessary to start our selection of medical students at the earliest age possible. Schoolchildren who have a bent towards handicrafts and mechanical toys and show the necessary patience and perseverance, should be kept under observation as possible future surgeons. If there is also an inclination towards observing nature and a liking for the study of biological sciences, it will be an additional qualification. In any case the aim of the medical curriculum should be in the words of the B. M. A. committee on medical education as follows:—

"The student must be trained in both the science and art of medicine. He must be equipped with the basic principles, scientific outlook and method and an intellectual resourcefulness and initiative in the handling of unusual and unexpected situations."

Coming now to the general principles of selection of medical students, the first essential is natural ability for medicine. In the present paucity of medical colleges, we cannot waste any seats on unsuitable material. We cannot afford to turn out inefficient medical men in the present state of acute shortage of doctors in our country and we must ensure that our people get full value for the money they spend on medical education. Therefore psychological tests for the suitability for a medical career should be instituted, if possible. Generally speaking the medical student should have the following attributes, as recommended by the Medical Education sub-committee of the Bhoré-Committee. "Minimum age 17. A healthy constitution and capacity for hard work. No physical defects especially as regards eyesight, hearing etc. Intelligence a little above the average should be expected. Economic stability is an advantage, but should not be insisted upon in the case of suitable persons who should be subsidized by the Government or the Society in the form of scholarships, exhibitions, prizes, etc. A certain amount of sports or athletic activity is desirable." Dr. Ryle has remarked "To balance the inevitable and necessary multiplication of specialists, we require as a leaven, a larger proportion of well trained general physicians and a higher average culture and attainment, in the coming generations of students destined for general practice."

Another point to be considered is that it is possible that even after very careful selection, some unsuitable candidates will be admitted in the medical colleges. Therefore ruthless weeding during the first few years in a medical college is desirable. In this connection, I am told recently that it is the practice of certain medical colleges in America to send a letter to inefficient trainees on somewhat the following lines. "Please co-operate with the management of this college by vacating your seat." We can choose some other form not so sarcastic or seemingly polite.

In the undergraduate period, the teaching of surgery should only have the following aims. "Teaching of general principles of diagnosis, elements of first aid, early recognition of surgical emergencies where an operation may save life. Surgery of minor lesions and infections. General scope of operative surgery without technical details, and general scope and methods of specialities such as anaesthesia, etc."

There is another aspect of undergraduate training in surgery. We can divide this in three parts, coaching, training and teaching. By coaching, we



mean preparing a candidate for an examination and thus make him exhibit his assimilated knowledge. By training we mean the acquisition of techniques by practical experience. By teaching is meant providing a fundamental introduction, critical survey and a challenge to original thought. It promotes judgment, insight, enthusiasm and inquiry. The problem of how to arrange about these three branches of surgical teaching is a very important one and I cannot do better than quote from a letter in the *Lancet* of April 27, 1946, by Michaelis. "Clever young graduates with a fund of systematic knowledge make good coaches. Able technicians may make good trainers. But teaching calls for a balanced view of the part and the whole, it demands a broad outlook and deep insight with scepticism for the established and an open mind for the new."

"When coaching is allowed to predominate in education the body medical presents itself as a cleanly dissected corpse. When training is given more than its due, the result is a Robot. Only when teaching is given its proper scope and precedence does this body medical emerge as a growing and living organism."

Therefore, coaching should always follow teaching but never coincide with or precede it. Training however may coincide with teaching but should never precede it.

In short, it is in the undergraduate period that it is even more important to choose teachers very carefully, those who are teachers first, trainers second, and coaches last. The under-graduate on the other hand is likely to prefer coaches and this should be discouraged.

I might add one word about examiners for the qualifying degree. They should desist from showing obscure cases and specimens and obsolete instruments and should accept views different from theirs, if they are part of the ordinary current teaching.

We now come to the next question that of training post-graduates and young surgeons. It is only during this period that the real development of the future surgeon takes place. The candidate desirous of joining the ranks of surgeons will have to be thoroughly prepared to surmount the hurdle in the form of a postgraduate qualification. This problem is therefore in the forefront as far as we in India are concerned. There is some difference of opinion about the exact period which should and must elapse between graduation and postgraduate qualification. At present two years are considered sufficient by many Universities. But most people consider this period too short and in England and America nothing less than 3 to 5 years is considered adequate. I believe that a period of 5 years, except in certain exceptional cases, is better as it is only during this period that in addition to know-

ledge and experience, certain other qualities in a surgeon have to be developed. The old saying of Thomas Fuller that a surgeon must have a "Lion's heart", an "Eagle's eye", and a "Lady's fingers" is not enough. Deep concentration, thoroughness and minute attention to details in surgical technique, a calm unflurried temperament, quickness of decision in emergencies, a completely scientific outlook, and ability to put in a sustained effort are also necessary. Some of these qualities even if inherent have to be developed by constant application and training. Future surgeons should keep in mind what Portia, in *The Merchant of Venice*, said to her friend Nerissa, "If to do were as easy as to know what were good to do, chapels had been churches and poor men's cottages Princes' palaces." They must not only know what to do, but must be taught how to do it. It is therefore necessary to set up high standards, remembering however that we should see that these standards are capable of achievement and also to see that it is useless to set up high standards unless adequate provision is made to train candidates up to those levels. At present the tendency of our Universities is to institute too many postgraduate degrees and diplomas and lay down syllabuses without finding out whether the necessary facilities for teaching for the same are available or not. This only leads to a condition almost pathological and may be named in a lighter vein, the disease of "Multiple diplomatism." We must also realise that surgery and its specialities require far more intensive and prolonged training than other branches of medicine and it is essential that we establish well equipped training centres for post-graduates, and make sure that when we plan hospitals, it is more important to train the hospital staff rather than collect the equipment only.

Before formulating details of postgraduate courses in surgery in our country, I would like to bring to your notice, a brief summary of the training given in the American Military Hospitals and the Toronto School of Medicine. In the American Veteran's Hospital, the average number of beds on the surgical side is about 1000 out of which 300 beds are allotted to general surgery, 150 beds for orthopaedic surgery, 100 beds each for urology, thoracic surgery, neuro-surgery and otorhino-laryngology and the remaining beds are divided between ophthalmology, plastic surgery and vascular surgery. The average number of beds per service is only about 30 and there is a resident post-graduate attached to each service. The duties of the "Resident" are as follows:—

1. Record carefully all histories and results of physical examination.
2. Order all special investigations.
3. Pre- and post-operative care of patient under direction of chief of service.
4. Assisting at all operations.



The actual training programme varies according to individual needs rather than a set course of study. But the general principles are as follows:—

1. Six months in the pathology department. Preparation and handling of specimens and slides and performing autopsies. A short course of lectures and demonstrations in pathology.

2. Surgical anatomy during whole course of postgraduate training.

3. Weekly classes in physiology, bio-chemistry, and bacteriology, with special reference to clinical application.

4. Attendance at the weekly conferences between professors of clinical and non-clinical subjects.

5. Six months in the diagnostic service under a physician.

6. Varying periods of 1 to 2 years in general surgery followed by one year in some speciality of choice. Total 4 to 5 years.

In the Toronto School of Medicine, the system is a combination of the tutorial and apprenticeship methods. In addition to practical training in the hospital, teaching for the M. S. degree is also provided for.

The general course is as follows:—

1. At least six months in general medicine and rotating internships.

2. At least six months in pathology.

3. One year in general surgery.

4. Six months in each of three chosen special branches.

Total of about 4½ years.

During this course, provision is made for teaching non-clinical subjects such as anatomy, bio-chemistry, bacteriology, etc. Attendance at ward rounds and staff conferences is insisted on and use of the library is encouraged for the purpose of gaining latest knowledge and for research.

Exceptionally this course is shortened, but may even be lengthened. For men going to small towns, as many specialities such as urology, pediatric surgery etc. as are possible are encouraged as short courses. The others spend six months in neuro-surgery and eighteen months more in the speciality of their choice. There is a special provision of laboratory facilities and only first class teachers are employed. For those ambitious to go on the teaching staff, the course is still longer.

At the end of these courses the candidates are allowed to appear for the M.S. degree and then they go out in practice, except those of outstanding ability, who become Fellows in surgery, are sent abroad for at least one year and are then appointed on the junior staff.

Coming to our own needs, I think we can assert definitely, the following fundamentals:—

1. Postgraduates should be chosen for their high intelligence, application, real interest in surgery and an intense desire to add to new surgical knowledge.

2. Prolonged resident training is the best.

3. Intensive training not only in general surgery and the specialities, but also in the basic sciences.

4. Recognition of the fact that the value of attending lectures, clinics or revision classes is small as compared to working in a hospital as one of the staff and passing an examination is only evidence of the fact that the candidate knew his textbook at one stage of his career.

We must therefore entirely scrap our present practice of six months resident post, next to no provision for revisional training in the basic sciences of anatomy, physiology, pathology, bacteriology, bio-chemistry, etc. and only two years between graduation and post-graduate qualification. No one can be a good surgeon, unless he has in addition to adequate knowledge of surgery, a firm foundation in the fundamentals of basic sciences. We must appreciate that increased knowledge requires more prolonged training and a post-graduate period of five years (three years in very exceptional cases) the whole of it preferably as a resident in a hospital should be substituted. About the other details, I am more or less in favour of the Toronto system with suitable modifications for our country in general and each University centre in particular.

I want to say a few more words about the post-graduate examination. Most Universities insist on the presentation of some sort of a thesis before the candidate is allowed to appear for the M. S. degree examination. This thesis, as far as my experience as an examiner at the M. S. examination of various Universities is concerned, is usually an ordinary write up of about 20 or 30 case histories and operations, and is usually of no value. I make a plea that this thesis should consist of complete case records of all important cases and should emphasize how the candidate's experiences and observations differed from the usually described text book picture, the reason or reasons why this occurred according to him and the conclusions he drew from these variations. It is only in this way qualities of accurate observation and the capacity to learn therefrom, can be acquired. This will also lead to the formation of reasoning habits and be an introduction to the elementary methods of original clinical research. I have also a suggestion to make to examiners at the higher examinations and that is that they should try and find out from the candidate, not simply facts gathered from various text books, but to ascertain his general outlook, reasoning faculty, judgment, temperament

and capacity to deal with individual problems.' It is only in this way that the efficient surgeon can be discovered and the paradoxical phenomenon we see to day, of some surgeons with brilliant academic careers but who are failures in the actual practice of surgery, will disappear.

When a person so carefully selected, trained and also examined for his postgraduate qualification with the requisite viewpoints, is allowed to join the ranks of surgeons, his surgical training is by no means over. Very often it has only just begun. It is only a truism to say that medical men and specially surgeons, have never finished their education and must remain to a certain extent life long students. It is only in the early surgical career, that one gains not only knowledge, but also accumulates wisdom, judgment, experience and the development of a tendency to rely less on books and more on personal observations and reasoning. Therefore it is necessary to interpose stepping stones in the forms of surgical registrar, chief assistant and assistant surgeon, before anyone attains the rank of chief surgeon, and professor of surgery. Of course, merit and capability should be the guides in deciding how quickly or how slowly these stages are gone through. I shall therefore mention at this stage the responsibilities and duties of teaching institutions and teachers towards these young surgeons. Firstly as regards the teaching institutions, they must first possess men with qualities of surgical leadership and they must be able not only to train students for examinations, but to train future surgeons and lead to the improvement of surgery as a whole. They must also be well equipped for conducting research and so gaining knowledge of new facts without which surgery can never advance. Therefore the authorities in charge of these institutions of learning should make it plain to the attending staff that they must not only be efficient themselves, but must also train the young surgeons who will take their place later on and this as part duties of their posts.

As regards the duties of teachers towards these young men, it is not appreciated by many that their first duty as members of the surgical staff of a teaching institution is to train future surgeons, and the ideal value of a teaching surgeon should not rest on how much skilful and impressive he has made himself by constant practice and repetition, but on how many young men he has trained to be as good as or even better than himself. Therefore teachers should avoid the old custom of using house surgeons and assistant residents as servants only and they should not feel it beneath their dignity to assist and train them. In all first class hospitals, the head or chief should only guide and supervise and the real routine work should be done by the juniors. Here I might mention the example of Serge Sergeï Yudin, the

great Russian surgeon who has twenty surgeons working under him while he himself only guides them. During this training, the teacher may find that his young assistant is at times showing slow progress. There is no discouragement in this and it may be that ultimately his pupil will suddenly attain proficiency in his work. It must be remembered that the attainment of surgical learning and technique is no Royal road, but a steep and hazardous path. Progress therefore at times may be inevitably slow. Leonardo da Vinci has said "He is a poor student who does not surpass his Master." I would like to reverse the saying this way. "He is a poor teacher who has not succeeded in producing at least one pupil better than himself." I am also reminded here of the Sanskrit saying, a free translation of which means, "A man desires to be victorious everywhere but is overjoyed when he gets defeat at the hands of his pupil."

There is one more thing I want to bring to your notice which will encourage and improve the young surgeon. This is the establishment of the Surgical Forum by the American College of Surgeons. The first session of this forum took place at Boston in 1941 but was interrupted by the war and resumed again at Cleveland in 1946. At this forum short papers of ten minutes each are read by surgeons of less than ten years standing before older people. No subject—whether preclinical or clinical—is barred and the paper must be a clear and concise presentation of original work and observations of the reader and not just summing up of old knowledge. Surgeons taking part in this Forum must be aware that blind rejection and blind following of anything is bad. The reasons why non-surgical and even basic sciences are not excluded are based on the fact that although there may be different Associations for the different specialities, the fundamentals are the same for all and it is superfluous to mention that all specialities must remain on the firm basis of the fundamental sciences, and will only go higher up if the foundations go deeper down into more solid ground. The American surgeons believe that the advantages of this Forum are many, chief among which is the opportunity for the young research worker to present his work and becomes a good publicity medium for new knowledge and information. It is well known that in the main the most important contributions as far as original work is concerned, are made by the young and we must encourage them in every way. It is also essential that for improvement in surgery, and enlightenment of older surgeons, young enthusiastic workers be given an opportunity for active participation in surgeons' meetings and the mixing of scientific outlook in surgery as opposed to pure handicraft is also desirable. To the older surgeon, this Forum benefits in many ways. This gives him an opportunity to keep abreast of the fundamentals and thus becomes somewhat of a refresher course for

him. One of the American surgeons has said, "unless one is with the advancing stream, one is left on the bank and far behind." Another surgeon says, "so that surgeons should not become narrow minded and so suffer from 'nutritional deficiencies' papers of general interest to surgeons, though non-surgical should be included in this Forum, even if necessary from non-members." The late W. J. Mayo has said "Wisdom of age and experience should be exchanged freely with the enthusiasm of youth and both would benefit by the barter." I therefore make a strong plea that the Association of Surgeons of India start such a Forum and I leave this pleasant but difficult duty of inaugurating it next year, as a legacy to my successor in Office.

I now come to the subject of the duties and obligations of senior surgeons and heads of departments or Professors. They must bear in mind that surgery is a sacred trust and only to be invoked when non-surgical means will be useless. The description by Celsus of the qualities of a surgeon, although not applicable in its entirety, still holds true to-day in many respects. He says, "A surgeon should be youthful or early middle age, with a strong and steady hand, as expert with the left hand as with the right, with vision sharp and clear and spirit undaunted. So far void of pity that while he wishes only to cure his patients, yet is not moved by his cries, to go too fast or to cut less than is necessary." Therefore the operator must take every step necessary to conduct the patient safely through the operation. As Wangensteen has said, "An operation like any biological experiment, can be performed only once. So prepare well for it. Death is so final." The late Wilfred Trotter has written, "Any operation must be anatomically and physiologically possible and must rest on pathological findings. Operative inventiveness must not outrun pathological foundations."

Therefore the surgeon must plan well before every operation and execute it cleanly and thoroughly remembering that the surgeon's time is never so valuable as the patient's life. The old saying in the case of the 'acute abdomen' of "get in quick" and "get out quicker" is not applicable in modern times as a result of the tremendous advances in methods of anaesthesia and treatment of surgical shock. Moynihan remarked that a surgeon with one eye on the clock and the other in the abdomen is a bad surgeon. A clean well planned and well executed operation is not however enough. Adequate post-operative care, with full knowledge of physiological considerations involved, is also necessary, and is even vital for the successful outcome of any surgical procedure. Here I might bring to your notice that there is such a thing as overtreatment and Wangensteen has told about an interesting case of a veterinary surgeon who gave too much vaccine to protect his dog from

distemper, too much strychnine to combat the effects of the vaccine overdose and too much ether to stop strychnine convulsions and so caused death of the dog.

The rapid strides of surgical advance during the last 25 years has also caused shrinkage in the field of general surgery and it is as it should be. No man, however talented, can be an expert in everything, and the surgeon must have the moral courage to say that the interest of the patient requires that some other surgeon operate on him. A surgeon who performs an operation for which he is not well prepared or one who performs unnecessary operations must be exposed and sternly suppressed. It is however difficult to believe if any such surgeon exists today. The exposure by Cronin in his book "The Citadel" of persons like Dr. Ivory must be an exceptional and isolated example. Albucasis has said even as long ago as about 1000 A.D. that "surgical operations are of two kinds, those which benefit the patient and those which usually kill him." A man who tries to do too much always remains a learner and can never be a teacher in one branch and as I have already mentioned about the duty of a teacher that his ambition should be to live in the next generation in the form of his students like Harvey Cushing has done. It is also my opinion that just as a surgeon begins his career by assisting and learning, he should end it by assisting and teaching.

Only when surgeons have succeeded in eliminating all 'avoidable' causes of death after operation can they be satisfied with themselves and they must remember the famous saying that "although this object may be unattainable, the very fact that we are striving to attain it, makes us better surgeons", and also the classical dictum "not failure but low aim is crime." Surgeons should always think of their patients and their own moods should correspond with the progress of cases they have operated on.

About surgeons as a whole I may quote the following remarks of Walton. "When a man's opinions become fixed his progressive work has finished. Vanity which increases with age, shows a constant desire to prove that views expressed long ago are still correct. Only as long as a man is prepared to admit that his previous conclusions have been shown by the light of more recent knowledge to be incorrect is his mind young, active and receptive. No surgeon therefore can ever feel that his knowledge is complete or find it derogatory to admit that others know more on one subject than himself. The advice of the most junior colleague should be sought as much as that of a senior. A surgeon must no longer be a worker for his own advancement, but a member of a large team working for the common good."

Even when a surgeon finds that he cannot accomplish much in the way of a cure of his patient,

he should be happy if he has done what Hippocrates said in the B.C. era and what Cabanes repeated in the 15th Century. "La presence d'un Medecin profite beaucoup. Son role est guerir quelquefois, soulager souvent, consoler toujours." The attendance of a surgeon should always be profitable. His role is to cure sometimes, ameliorate often, console always.

I now come to a brief summary of requirements for research in surgery. As is well understood, knowledge becomes static without research and it should be the aim of everybody to add to the sum total of our knowledge. We should remember what Sir Michael Foster said, "It is one of the lessons of the history of science that each age steps on the shoulders of the ages which have gone before," and just as we stand on the shoulders of our predecessors, our students must stand on our shoulders, if they are to have a further and clearer outlook. Surgical progress now depends on our past progress and its foundations. In research John Hunter's dictum, "never think. Experiment," always holds true. Research in medicine as a science however unlike research in pure sciences like chemistry and physics does not depend on pure scientific observations alone, and sometimes outside or extraneous observations must come in. Medicine as a science is not pure applied physiology or pathology, just as geology, astronomy, or meteorology are not pure applied physics, mathematics, or chemistry. Just as geology or meteorology would never have progressed if they had depended on progress in physics and chemistry, medicine or surgery will never progress if they depend on progress in applied physiology or pathology. Here comes in clinical material, observations and records and although "art" of medicine will long remain the chief standby of the practical medical man, research and progress in the clinical sciences are equally necessary. The saying that the "touchstone of scientific methods is the universal validity of results" may be true in sciences such as refraction, bacteriology, bio-chemistry, etc. Very strict application of this saying and complete scientific precision in medical science may become a trap and occasional "art" must come in. As Ryle says "The problems of man in diseases will always require for their solution, processes additional to strict scientific assessment." Therefore real advance in medical research can only take place if this research is carried on simultaneously in all the branches—pure sciences such as bio-chemistry, topical sciences such as physiology and pathology and the clinical sciences. This can only be done in well equipped laboratories and research institutes attached to large hospitals. Consequently we should recommend and almost insist that everyone connected with the medical colleges—Governments, Municipal Corporations, or even private or Missionary Societies to have an outlook

which "counts the cost less and values the result more" and plan and establish properly equipped research departments in their colleges. Research workers must not lose confidence and patience in the work they are doing, remembering that even if they have reverses, a strong determination not to fail will assure them of success and also bear in mind the words of Trotter, "The reception of new ideas tends always to be grudging or hostile." All pioneer workers have always had to face opposition—almost enmity—, scorn and ridicule as is seen by the famous examples of Pasteur and Lister. Men trying to find out the secrets of the medical sciences must keep themselves on the straight and unwavering path keeping only the goal in sight and disregarding impediments and obstructions on the way.

There is another problem before us about medical research. Surgery can only advance by interchange of ideas at the highest possible level and hence it is necessary that we have in our great country of to-day—and which is going to be equal to the greatest in the near future—a Central Research Institute on the lines of the Lister, Pasteur or Rockefeller Institutes. We must not only borrow and copy foreign ideas, but be in a position to be able to exchange our ideas with theirs on an equal footing. As it is necessary for success in this object, the study of foreign languages is essential and the minimum requirement in a big institute should be that one member at least, knows at least one of the important foreign languages such as English, French, German, Spanish and Russian. I have mentioned the Russian language last, but it is, I think, of the greatest importance today. The advances in the knowledge of medical sciences are far reaching and great in Russia of today and to show how the ignorance of the Russian language hampers our progress, I shall quote an extract from the *Lancet* of 4-8-1945, page 153.

"In his own speciality in England, your correspondent can count the number of full time research workers on the fingers of one hand and have more than one finger to spare. In the same speciality in Moscow, he found all his fingers and toes inadequate to keep the count. In fact, he had to borrow an abacus. More reprehensible still, was the fact that these research workers appeared to have no sense of shame or compunction over their careers and situations in life. Strangely enough, the research worker in the Soviet Union is really regarded as a useful person. No one seems to need convincing that science and research have a place in the social organisation, and Soviet medicine appears to be capable of absorbing as much research talent as the Union can produce. The large hospitals are organised on the conception that they are not merely treatment centres, but also research stations. Each clinical speciality has a large and well equipped clinical unit surround-

ed by a battery of clinical research laboratories. The whole is integrated into a finely co-ordinated institute and is so named. Some of the research workers confine themselves entirely to the laboratory but most combine fundamental scientific research with clinical duties. There is free intercourse between the staff so that there is a continuous flow of clinical and laboratory information, and great deal of co-ordinated investigation. The Russians call this planned research. To your correspondent, it was plain common sense. To see research work in any particular clinical speciality it was not enough to visit the institute devoted to that speciality. Well qualified workers in excellently equipped laboratories were to be found in the other clinical institutes, where this particular speciality was one of the contributory departments. This too is according to the Gospel and plan, but it seemed an excellent way of avoiding excessive centralisation in a country. The Soviet research workers appear to be far better informed of the work in the other countries than the stray foreign visitor seemed to be of Soviet work. We all blamed the difficulty of the Russian language, and felt ever so much better having laid the blame four square where it belongs."

If this is the state of affairs in England, how much worse must it be in our country where knowledge of the Russian language is almost non-existent.

I have another suggestion to make and that is to compel every research worker to take an oath—just as we medical men take the Hippocratic oath—and the words of this are suggested by Dr. Weltfish and quoted by Aldous Huxley. The oath is as follows:—

"I pledge myself that I will use my knowledge for the good of humanity and against the destructive forces of the world and the ruthless intent of men and I will work together with my fellow scientists of whatever nation, creed, or colour for these our common ends." This oath is necessary at the present moment as every body is talking of atom bombs and V-rockets and not a word about saving humanity.

I now come to a few observations on surgery in general, surgery as a science and, surgery as a profession. In the early days surgery was considered an art and was relegated to barbers—even to-day in India, the village barber removes thorns and opens abscesses—while medicine was considered a philosophy only for the learned. The very word surgery means use of hands, as the Greek words 'cheir' and 'ergon' mean 'hand and to work. Even to-day surgeons are looked upon by men—even medical men—as manual labourers. Some still believe there is more art than science in surgery and it is only a trade. These views are however gradually changing and it is now realised

that surgery is to-day as much—or perhaps as little—a science as the other branches of 'medicine'. Surgeons employ hands in the service of their brains and only well trained surgeons can dissipate the medical ignorance about them. In any case, increasing team work has overcome in many cases, the artificial separation of medicine, surgery and the auxiliary sciences. It is wellknown to-day that a surgeon must know enough medicine to be able to diagnose medical conditions and a physician must know what operation should be performed although he may not be able to do it himself. The aim of 'medicine' in the past was curative; but everyday it is becoming more and more preventive and it may come to pass that even though to-day the highest attainment of surgery is to aid nature, in course of time, as 'medicine' progresses, surgery may attain its true aim, that of its own extinction, except perhaps surgery of trauma and congenital defects, though we have a long way to go yet to reach that aim. Surgery of gummata has disappeared. Penicillin has restricted the need of surgical intervention and with increasing research, surgery of malignant tumours may disappear any day. Science of surgery, of course, owes a deep debt of gratitude, apart from the discovery of anaesthesia, to the work of men like Pasteur and Lister. In a biography of Lord Lister, the following sentence is written. "If some day, surgery should reach its ultimate goal of eliminating itself, it will be at least partially due to the man, who made surgery a relatively commonplace affair, multiplying by an astronomical figure the number of operations that could be performed." Ogston, a contemporary surgeon of Lister wrote to him "You have changed surgery, especially operative surgery, from a hazardous lottery into a safe and soundly based science."

I have referred upto now to surgery as a science. But it is not entirely a science. It is still a practical art, an applied science, and an experimental science. The fact that surgery is still partly an art is nothing to be ashamed of. Trotter's writing "now that the prestige of science is so high, the statement that a great part of medicine still retains the status of an art is often made with a note of apology. Nothing could be less justified by a realistic sense of cultural values" is aptly applicable here.

About surgery as a profession, I have already mentioned many qualities and requisites necessary in men practising it. I shall mention a few more. According to Trotter, "soundly cultivated judgment is the best thing. It depends, apart from in-born capacity, on familiarity with the material of the art." This shows the necessity of continuous contact with clinical material. Kreke, a German surgeon says, "Surgery requires more than ordinary nervous strength in its disciples, and a surgeon must have as a gift of nature, a certain opti-

mism, confidence and belief in himself that he will accomplish what he undertakes." Surgeons must also be aware of the fact that the days of the one man surgeon are over and only a well trained team is capable of better work. There were good surgeons—nay even better surgeons—in the past; but it is only the organisation of the team, anaesthesia, asepsis and a better understanding of shock and nutrition problems that is showing better results to-day. Surgery demands at the present time, high level of concentration and harmonious co-ordination of eye, hand and mind. In addition to Fuller's "eagle's eye", "Lady's hand", and "Lion's heart", surgeons must also possess a strong pair of legs and a perfectly healthy spine. After a difficult and prolonged operation, the surgeon himself sometimes stands more in need of "post operative resuscitation." We must also remember that the future surgeon may have less income, but will have that which will give greater happiness in life than financial profit, interesting and joyful work, and as the "tissues of the rich and the poor" are the same, the often silent but touching gratitude of a patient is more of a reward than money. W. J. Mayo has remarked that "a contented industry is the mainspring of human happiness." We, as surgeons, should endeavour to hear from our patients the same remarks as Queen Victoria made to Lord Lister after a minor operation on her—"a disagreeable duty most agreeably performed."

I want to say very little more before I conclude. Syme—the father-in-law of Lord Lister had the reputation of not ever wasting a word, a drop of ink, or a drop of blood. In my address upto now, I have wasted many words and perhaps bottles of ink. But I think all of you will agree with me that I shall be wasting not a word, not a drop of ink, and certainly no blood, when I quote a sentence from one of the letters Lord Lister wrote to his father, "Truly the practice of surgery is a glorious occupation."

The Opening of the Surgical and Scientific Exhibition was then performed by Dr. Badri Narain Prasad, who, while thanking the exhibitors and wishing them all success, expressed his sense of delight over the fact that Bihar would soon have an industry for the manufacture of pharmaceutical articles.

In addition to various Surgical instruments and apparatuses (many manufactured in India), several splendid Anatomical dissections carried out in the Department of Anatomy of the Prince of Wales Medical College were also displayed.

*Governing Body (1st Meeting).*—This was held at 12 Noon in the Library Hall of the Prince of Wales Medical College, Dr. Joglekar presiding.

Seventeen members proposed during the year were duly admitted and the resignations of six members were accepted. A preliminary discussion regarding "Short papers" that are to be presented at the Annual Conference was held.

It was also decided to appeal for more funds for the library of the Association.

A sub-committee consisting of Drs. N. S. Narasimhan, C. P. V. Menon and U. Mohan Rau was formed (1) to improve the library of the Association, and make it useful to all the Members, and (2) to draft the bye-laws for the conduct and publication of the Indian Journal of Surgery.

The Members reassembled again at 1 P.M. at the P. W. Medical College. Drs. A. V. Baliga and R. N. Cooper then presented their papers on "Intracranial Tumours" and an interesting discussion followed.

That evening the members were entertained to tea by the Vice-Chancellor of the Patna University. This was followed by an enjoyable musical entertainment by the Patna Amateurs at the Lady Stephenson Hall. The day's activities were rounded off by a very pleasant buffet supper at which Dr. T. N. Banerji, the President of the Reception Committee was the host.

31-12-1948

From an early hour in the morning, the members were kept busy by visits round the Hospitals and College and by demonstrations of surgical procedures like cholecystectomy, thoracoplasty, etc. In addition to these, as a welcome innovation, a few "short papers", were read in the lecture theatre in the College under the Chairmanship of Dr. Joglekar. The following papers were read:—

1. "A new incision for exposure of the gall bladder" by Dr. J. S. Carman, Vellore.
2. "Ileo-caecal Tuberculosis" by Dr. B. N. Banerji, Darbhanga.
3. "Anatomy of the pelvic sympathetics" by Dr. G. K. Ghosh, Patna.
4. "A case of Xiphopagus Monster," by Dr. R. Nigam, Nagpur.

Each paper lasted for about 15 minutes and only questions were permitted to be asked; no general discussion was allowed. (The papers were so instructive and useful, that several members expressed a desire to make this item a permanent feature of our Annual Conferences.)

*Editorial Board.*—At a meeting held at 12 Noon, several members suggested ways and means of im-



proving the Indian Journal of Surgery. A general directive was given to the sub-committee that was to draft the bye-laws for the conduct and publication of the Journal.

After lunch, Dr. Kalamegham read his paper on "Talipes Equinovarus". He demonstrated his points in the treatment of this condition by an instructive movie produced by him. Several members took part in the subsequent discussion.

At this stage Dr. Baliga showed a beautiful film on the "technique of the osteoplastic flap, etc." as practised by him. (This was not shown on the previous day owing to some technical difficulty.).

His Excellency the Governor of Bihar was "At Home" to the members that evening. Individual introduction and tea being over, the members spent a pleasant evening at the Government House.

The Annual Dinner of the Association was held at the P. W. Medical College. Covers were laid for over 250 persons. In addition to the Ministers for Public Health and Finance, several distinguished citizens of Patna (medical and non-medical) graced the occasion with their presence. The Minister for Public Health proposed the toast of the Association; this was responded to by the President, Dr. Joglekar. The toast of the Guests was proposed by Col. Mirajkar and the Minister for Finance suitably replied. The function was quite pleasant and was a grand success.

1-1-1949

The Scientific Session for this day started at 9-15 A.M., Drs. Vaishampayan and Baliga presenting their respective papers on "Surgical Complications of Typhoid". Several members partook in the good discussion on this subject.

*The X Annual General Meeting.*—This was held at 12 Noon in the Main Lecture Theatre of the College. Dr. S. R. Joglekar presided over this meeting. More than 50 members were present.

After the President's opening remarks, a condolence resolution on the death of four members of the Association, viz., Drs. H. D. Gandhi and N. F. Saher of Bombay, Dr. T. Bhaskara Menon of Vizagapatam and Dr. Subinoy Sen Gupta of Patna, was passed, and the Hony. Secretary was authorised to convey this resolution to the members of the bereaved families.

The Minutes of the previous Annual General Meeting, the Annual Report for 1948, together with the audited Balance Sheets were then presented by

the Hony. Secretary and were all accepted by the House.

The President then announced the nominations for the Presidential Election. There were two names, viz. Dr. P. Chatterjee from Calcutta and Rai Bahadur Dr. G. D. Kapur from Assam. As Dr. Kapur withdrew from the election, Dr. Panchanan Chatterjee was elected unanimously as the President for 1949.

The list of subjects that were to be discussed at the 13th Annual Conference was then taken into consideration. As there were more than thirty subjects on the list, the Governing Body was authorised to make the selection.

The venue of the next Conference was next considered. As many members were desirous of holding the next Annual Conference at Vellore, Prof. Carman from Vellore Medical College, was requested to ascertain the feasibility of holding the XI Annual Conference at Vellore\*. In case Prof. Carman advised against holding such a Conference in 1949, the Hony. Secretary was authorised to accept the invitation from Madras.

The President then made an appeal to the Members to donate liberally to the library of the Association. "Not only money" he said, "but periodicals, books, and reprints, etc., are welcome". He assured them that in a short time, facilities for reference from this library would be extended to all members—both in and outside Madras.

During the discussion that followed, a resolution to the effect that the Association of Surgeons of India requests the Government of India and the Provincial Governments to start Central Reference Libraries for the use of the medical profession in general and the Surgical Profession in particular, was passed.

It was also resolved that the titles of the subjects for discussion at the future Annual Conferences should be sent to the Hony. Secretary one month before the date of the Annual General Meeting (e.g. subjects for 1952 to be sent to the Secretary before the last week of November 1949 so that a list may be prepared for the Governing and General Body Meetings during December, 1949).

After the President's concluding remarks, Dr. U. P. Sinha, proposed a vote of thanks.

The new President, Dr. Panchan Chatterjee, was then led to the chair by the out-going President.

\*Subsequent to this Prof. Carman has expressed his inability to invite the Conference to Vellore in 1949 as he and several other members will be away from India during the latter half of 1949. Hence the XI Annual Conference will be held at Madras during December 1949.

While welcoming the new President, the Hony. Secretary paid tributes to the out-going President, Dr. Joglekar, and also to Dr. U. P. Sinha and his marvellous band of colleagues, friends and student volunteers.

With a few remarks by Dr. P. Chatterjee, the meeting came to a close.

After this the group photo of the Association was taken.

\* \* \*

*Governing Body (2nd Meeting).*—This was held at 3 P.M., Dr. Panchanan Chatterjee presiding. Fifteen members proposed during the Conference were provisionally admitted.

From the list of subjects presented at the Annual General Meeting, the three subjects (which are given below) were selected for discussion at the 13th Annual Conference to be held in 1951:—

1. *Hydrocephalus*—

Opener: Dr. A. E. DeSa', Bombay.

Seconder: Dr. S. K. Sen, Delhi.

2. *Prolapse of the Rectum*—

Opener: Dr. K. G. Munsif, Bombay.

Seconder: Dr. S. N. Mathur, Lucknow.

3. *Tuberculosis of the Hip Joint*—

Opener: Dr. A. K. Basu, Calcutta.

Seconder: Dr. B. N. Sinha, Lucknow.

It was also decided to invite Short papers to be read at the Annual Conferences in future. The details of these papers (viz. duration, etc.) were also discussed. (These are announced separately).

\* \* \*

That evening, the members were taken to Rao Sahib Jalan's Residence, where a very rare and excellent collection of pottery, works of art, ancient jewellery, ancient scripts, etc. were exhibited and explained to the members. Later, on a verandah overlooking and almost on the bank of the Ganges, the members had refreshing tea.

\* \* \*

The most enjoyable event was the dinner that night at the Flying Club, Patna. The calm atmosphere of the place, far away from the City, the sumptuousness of the buffet dinner, the spirit of friendship and camaraderie among the members and above all, and genial and generous personality of Dr. U. P. Sinha, the Local Secretary, our host that night,—all these have made this dinner one of the happiest events of an extremely successful and useful Annual Conference.

\* \* \*

### Subjects for Discussion

The following are the subjects for discussion at XI Annual Conference of the Association of Surgeons of India to be held at Madras during December, 1949.

1. *Treatment of Elephantiasis and Lymph Oedema*—

Opener: Dr. V. P. Mehta, Bombay.

Seconder: Dr. T. Kanakaraju,  
Ramachandrapuram.

2. *Treatment of Hernia with Fascial Grafts and Silk Sutures*—

Opener: Dr. P. Chatterjee, Calcutta.

Seconder: Dr. S. K. Datta, Calcutta

3. *Treatment of the Bone Cavities in Chronic Osteomyelitis*—

Opener: Major D. K. Sabhesan, Madras.

Seconder: Dr. B. N. Sinha, Lucknow.

In addition to these, members are requested to present during this Session, "Short Papers".

(i) Any subject of interest to the surgical profession can be selected for a Short Paper.

(ii) Each paper should not exceed a maximum of 15 minutes.

(iii) Apart from questions, no discussion is allowed on these papers.

(iv) Copy or copies of this paper may kindly be sent to the Hony. Secretary, Association of Surgeons of India, 207, Poonamallee High Road, Madras 7, before the 30th of September, 1949.

Members are requested to take part in the presentation of these Short Papers and make the Conference one of maximum benefit to all present.

### 12th Meeting:

1. (a) *Bronchiectasis*—

Dr. R. Mahadevan, Madras.

(b) *Lung Abscess*—

Dr. S. J. Mehta, Bombay.

2. *Intestinal Obstruction in Children*—

Opener: Dr. A. E. DeSa', Bombay.

Seconder: Dr. R. A. Irani, Bombay.

3. *Sciatic Syndrome*—

Opener: Dr. S. K. Sen, New Delhi.

Seconder: Dr. V. P. Mehta, Bombay.



## 13th Meeting :

## 1. Hydrocephalus—

Opener : Dr. A. E. DeSa', Bombay.

Seconder : Dr. S. K. Sen, Delhi.

## 2. Prolapse of the Rectum—

Opener : Dr. K. G. Munsif, Bombay.

Seconder : Dr. S. N. Mathur, Lucknow.

## 3. Tuberculosis of the Hip Joint—

Opener : Dr. A. K. Basu, Calcutta.

Seconder : Dr. B. N. Sinha, Lucknow.

## Library

The Hony. Secretary, Association of Surgeons of India, acknowledges with thanks the receipt of the following Books and Journals presented to the Association's Library by :

A. Lt.-Col. K. G. Pandalai, I.M.S. (Retd.)

—Founder President.

Total No. of Books received .. 200

B. Dr. S. B. Gadgil, F.R.C.S., Bombay  
—Ex-President.

Total No. of Books received .. 9

Full details of the books will be published in the June, 1949 issue of the Indian Journal of Surgery.

## Correction

In the article "Ureter Transplantation in Cancer of the Bladder" (Vol. X—No. 3, Sept. 1948 issue) —page 295, line 7 of column 1, is to read as "Royal Society of Medicine" and not "Royal Society".

We regret the error.

## International Congress on Rheumatic Diseases

The first International Congress on Rheumatic Diseases will take place at the Waldorf Astoria in New York City, U.S.A., from the 30th of May to the 3rd of June 1949 inclusive. Those desirous of attending this Congress are requested to get in touch with Mr. Edwin P. Jordan, M.D., Chairman, Publicity Committee, 2020 East 93rd Street, Cleveland 6, Ohio.

## Contributors—March, 1949.

1. G. D. Veliath, M.D., Prof. of Pathology, Stanley Medical College, Madras.
2. G. S. Viswanathan, M.D., Prof. of Pathology, Medical College, Vizagapatam.
3. R. Kalamegham, M.B., B.S., Nursing Home, Trichinopoly.
4. V. M. Kaikini, F.R.C.S., Surgical & Maternity Hospital, Charni Road, Bombay 4.
5. R. Nigam, M.S., F.R.C.S., Professor of Surgery, Medical College, Nagpur (C.P.).
6. P. P. Chandu Nambiar, F.R.C.S., 12, Ritherdon Road, Madras 7.
7. N. S. Narasimhan, F.R.C.S., 221, Thambu Chetty St., Madras 1.

# THE INDIAN JOURNAL OF SURGERY

Vol. XI

JUNE 1949

No. 2

## INTRACRANIAL TUMOURS\*

by A. V. BALIGA, *Bombay.*

The paucity of papers on intracranial tumours in our country has been the sole stimulus for starting a discussion on this difficult subject. It is time we focus our attention on this surgical problem. It is common experience that intracranial tumours are often diagnosed too late for any radical surgical undertaking to benefit the sufferers.

It is made clear at the outset that the personal review of the cases and the experience of operative procedures is small. It is a story of disappointments and is presented to show that it requires a stout heart, sustained academic interest and intense optimism to be able to pursue this branch of surgery which at present is enveloped in pessimism, gloom and ignorance all round.

Incidence of intracranial tumours is not at all small, compared to that of neoplasms in general in the body. The relative frequency of the various types of these brain tumours was given in an analysis of 1,398 cases in 1927 by the father of modern neurosurgery Harvey Cushing:—

Gliomata	.. ..	42.4 %
Pituitary adenomata	.. ..	19.4 %
Suprasellar cysts	.. ..	5.1 %
Meningiomata	.. ..	11.9 %
Neurinomata	.. ..	8.8 %
Metastatic	.. ..	4.0 %
Granulomata	.. ..	2.8 %
Miscellaneous	.. ..	5.6 %

The Miscellaneous group includes cholesteatomata, blood vessel tumours and papillomata.

130 tumour cases have been collected from the records of the K.E.M. Hospital,

Bombay, from the years 1926 to 1948. Only 59 cases are analysed below as these are the only cases that have a definite pathological diagnosis. It is sure that there were more cases but due to defects in recording, some patients have been left out. For example 3 personal cases and 2 cases of cholesteatoma under Dr. Cooper are not included in this series as records were not available at the time of collection of statistics.

Gliomata	..	17	—	28.8 %
Pituitary adenomata	..	15	—	25.4 %
Suprasellar tumours	..	4	—	6.7 %
Meningiomata	..	10	—	16.9 %
Neurinomata	..	6	—	10.1 %
Tuberculomata	..	4	—	6.7 %
Hemangioma	..	1	—	1.8 %
Endothelioma of choroid	..	1	—	1.8 %
Retinoblastoma	..	1	—	1.8 %

Total .. 59 100

The following table shows the dismal state of affairs regarding the diagnosis and localisation of cerebral tumours:

Clinically diagnosed	..	110
Pathologically diagnosed	..	59
Localisation done	..	48
Post-mortem diagnosis	..	34
Pure accidental finding during post-mortem	..	16
Diagnosed as cases of cerebral tumours and operated for the same but no tumour was found during post-mortem	..	2

It is interesting to analyse the 16 autopsies where cerebral tumours were revealed by accident. The post mortems were done for various causes such as coma, multiple fractures, broncho-pneumonia, suspected poisoning, arteriosclerosis, cerebral haemorrhage, mastoiditis, anaemia from anky-

\* A paper read at the X Annual Conference of the Association of Surgeons of India during Dec., 1948.

lostomiasis, and chronic osteomyelitis. A good half of the tumour patients were admitted and remained on the medical side and were either discharged or died without any attempt at giving them surgical relief.

**Gliomata:**—Practically all brain tumours arise from neuroglia—the supporting frame work. The neuroglia in their turn are derived from the medullary epithelium, an ectodermal derivative from which also the nerve cells, the neurons, are developed. A study of the evolution of the neuroglial cell shows that in the early stage of embryonic development, there is, on the dorsal surface of the embryo, a "neural plate", which becomes a neural groove and later depressed below the skin surface, gives rise to a tube lined by a single layer of epithelial cells—medullary epithelium. From this medullary epithelium develop the nerve cells proper and the supporting frame work, neuroglia. The primitive neuroglial cell as is seen in the scheme, is the spindle shaped spongioblast which undergoes various modifications till it eventually attains the adult form, the astrocyte. Astrocyte is a star shaped cell with many spidery processes, of which, one is a sucker foot attached to a capillary vessel. There are two varieties of astrocytes—the fibrillary and protoplasmic. Medulloblast is the indifferent, bi-potential cell able to form both nerve cell and neuroglia.

Bailey and Cushing have emphasized that in brain tumours, as in tumours elsewhere, the more primitive the predominating cell, the more malignant is the behaviour of the tumour. Thus a spongioblastoma would grow fast and kill rapidly. An astrocytoma being mainly of the adult cell, would be slow growing and but for its peculiar situation in the skull box would be innocent. In tumours, probably, the neuroglial cells revert to their various primitive type and depending on the extent of such dedifferentiation, the various groups of gliomata are recognised based on the morphology and histo-pathology. Before considering the individual members of the glioma family, it must be pointed out, that, these tumours do not present a pure "culture" of the type of

cells of one order. The predominating cell type determines the group.

Bailey, Cushing and Penfield have done a lot to elucidate the pathology and classify rationally the large group of gliomata. From a critical study of 254 verified gliomata, Bailey and Cushing in 1926 sub-divided these on a developmental and structural basis into 15 classes. Later Bailey in 1932 has dropped certain of the sub-divisions as unnecessary.

**ASTROCYTOMA**, being composed of astrocytes, is a slow growing relatively benign tumour in the pathological sense and fortunately the commonest in the glioma group. It is located commonly in the frontal lobes and it occurs in adults. Less frequently it is found in the cerebellum in which case it is always in children. It forms a pale swell-



Fig. 1.  
Astrocytoma Cerebrum.



Fig. 2.  
Astrocytoma Cerebellum.

ling merging indistinctly into the surrounding brain. It forms on the surface a widening and flattening of the convolutions and diminished vascularity. Cystic degeneration is very common with a little nubbin of tumour in the wall. The cyst wall is avascular but not the tumour tissue. The fluid in the cyst is straw coloured, more viscid than cerebrospinal fluid, and has a high albumin content. It clots on standing. (Figs. 1 & 2.)

*Microscopically* the tumour is composed mainly of astrocytes fibrillary or protoplasmic—and the intercellular substance varies in amount. There are few vessels and practically no mitotic figures. Sometimes there are large giant cells as a prominent

feature and Roussy and Oberling called this variety giant called astrocytoma. (Figs. 3 & 4.)

*The clinical picture* : Being of slow evolution, and commonly in the frontal lobe, there may be no symptoms for long. Forgetfulness is one of the first symptoms noted and later lack of judgement and lapses in social behaviour. If situated near the motor area, weakness and other motor symptoms are added and progressively increasing papilloedema and headache become manifest. Cerebellar location would usher in symptoms and signs of cerebellar involvement.

*Treatment* : This is a very favourable group of tumours for surgical attack. In supratentorial tumours a suitably fashioned osteoplastic flap is made overlying the tumour, the widest and flattened gyrus is recognised and the tumour is located by gentle palpation with the finger for any altered consistency. By using a small bore aspirating needle, fluid may be drawn which will clinch the diagnosis or as the needle is being pushed through, the varying resistance of tissues during needling may detect the existence of the tumour. Any cyst encountered is emptied and cut into with a diathermy knife or if ordinary knife is used, vessels around are previously secured. With the help of light illuminating retractors, tumour nodule is spotted in the wall and such a nodule completely excised. If this nubbin of tumour tissue is not removed recurrence is to be expected. It is surprisingly easy to push the surrounding healthy brain tissue away from the cyst wall that is being extirpated. Outlook is comparatively good, the average survival period after operation in Cushing's series is nearly 6 years.

**GLIOBLASTOMA MULTIFORME** of Bailey and Cushing is the generally accepted term applied to the second common group of gliomata. Globus and Strauss call the same spongioblastoma multiforme. It is the most malignant form of glioma, seen in persons between the ages of 40 and 50. It forms a vascular, pseudocapsulated tumour, exclu-

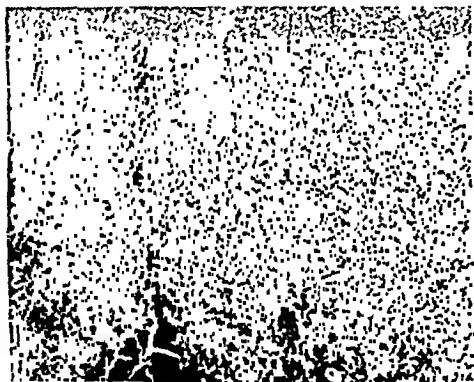


Fig. 3.  
Astrocytoma

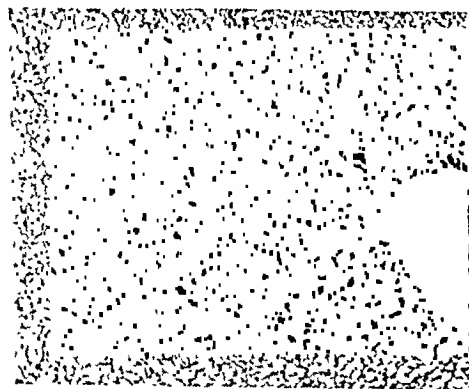


Fig. 4.  
Astrocytoma.

sively in the cerebrum and most often in the frontal lobe. Haemorrhage and degeneration with widespread cerebral oedema are common and determine an early fatal termination. (Fig. 5.)

*Microscopically* you find all manner of cells, spongioblasts of every description, astroblasts, astrocytes, giant cells and so on. Cellular pleomorphism, well marked vascularity and an abundance of mitotic figures are all very characteristic — a histo-pathological picture not dissimilar to a spindle-celled sarcoma.

The *neurological symptoms and signs* are that of the preceding astrocytoma group but the evolution is rapid and symptoms of intracranial hyper-tension early. Operations are only palliative. Soft and degenerated part of the tumour is removed with an electric loop and wide decompression affected. Post-operative deep x-ray therapy is of some value. Cushing's survival period for this group is 12 months.

**MEDULLOBLASTOMA** is a tumour of childhood, mostly in the cerebellum in the region of the vermis and the roof of the fourth ventricle. It forms a very vascular solid reddish tumour and it is the third common type of glioma. It disseminates rapidly along the meninges in the subarachnoid space at the base, producing hydrocephalus. *Microscopically* the neoplasm is composed of small cells with little cytoplasm and hyperchromatic nuclei. Mitoses are frequent. There is a resemblance to a round cell sarcoma. (Fig. 6.)

*Clinical picture* is of a child — about the age of 10 — who starts with attacks of vomiting which are treated by the Pediatrician as a gastrointestinal upset. Later the vomiting persists, gait becomes unsteady and the vision deteriorates quickly. There is pain in the neck and child resists flexion of the neck. In trying to flex the neck, one may bring on a cerebellar fit described by Hurlers Jackson in which convulsion occurs with an arched back and extended limbs with perspiration and irregularity of pulse and respiration. The skull on percus-

sion yields a cracked-pot sound because of sutural separation.

*Treatment*: The growth is readily controlled by deep x-ray therapy but eventually kills. An operation is often carried out with the purpose of establishing the diagnosis.

Astrocytoma, spongioblastoma and medulloblastoma together constitute three-fourths of the glioma group. Rarer forms of glioma are oligodendro-glioma, spongioblastoma, astroblastoma, ependymoma, pinealoma, ganglioneuroma and neuroepithelioma.

Pituitary tumours of the intrasellar variety, constitute 19.4% of all intracranial tumours. The bulk of these are either chromophobe or eosinophil type of adeno-



Fig. 5.  
Spongioblastoma Cerebrum.



Fig. 6.  
Medulloblastoma.

mata. In the series reported by Dott and Bailey, the chromophobe group are about thrice as frequent as the acidophil kind.

Of the 59 cases in this series where definite diagnosis was made, 15 were intrasellar pituitary tumours giving an incidence of 25.4%. Of the 15 pituitary tumours 11 were chromophobe type and 4 were eosinophilic, proportion strictly comparable to that of Dott and Bailey's series. The incidence of intrasellar tumours in this series is 25.4% while that given by Cushing is 19.4%.

CHROMOPHOBE ADENOMATA are the common hypophyseal tumours, they do not contain *alpha* and *beta* granules, and the cell arrangement is in alveoli lined by columnar or polygonal cells in a connective tissue stroma, or a formless cell collection with scanty stroma and oval nuclei with abundant chromatin. The gross appearance otherwise is the same as that of eosinophilic adenoma except that the latter is smaller and grows more slowly.

The *clinical picture* is a combination of hypopituitarism, neighbourhood phenomena and a ballooned sella turcica.

Hypopituitarism manifests itself in the form of sexual infantilism. In childhood there is genital under-development and in the adult we find amenorrhoea and sterility in the female and loss of sex libido in the male. The usual hypopituitary type is the adiposogenital syndrome whether in a child or in adult. Other features are fine skin, scanty hair in the axilla and over the body indicating a reversion to the feminine type. In addition, basal metabolism is lowered and sugar tolerance is increased. Neighbourhood phenomena are headache from tension under the diaphragma sellae, pressure on the chiasma giving bi-temporal hemianopia of the upper quadrant type and pressure over the diencephalon with somnolence.

Treatment principally aims at the saving of vision. With deep therapy, if vision does not improve, then an operation is indicated. Transfrontal route is selected lifting the frontal lobe, incising the dura at the sphenoidal

ridge, lifting up intradurally the frontal lobe further deep and exposing the optic chiasma. Generally, the tumour presents from below the chiasma and appears on the anterior aspect of the chiasma. Remembering and avoiding important vessels like anterior cerebral and the internal carotid main stem, incise capsule and scoop. Too vigorous scooping and suction may mean severe irremediable hypopituitary picture. The object of surgery is to save vision, relieve headache and conserve the remaining normal pituitary gland tissue from further pressure atrophy. The nasal or transphenoidal route has been universally abandoned because besides giving a limited exposure, it carries a real risk of infection and the further risk that normal remnants of the important gland may be punched away. It is specially to be pointed out, that it is the upper part of the pituitary tumour — particularly the suprasellar portion — that produces pressure symptoms and that this part is inaccessible to the nasal attack, whereas, the tumour is seen, its character recognised and tackled appropriately by the transfrontal route, for which, the right side is generally selected.

EOSINOPHILIC ADENOMA is associated with hyperpituitary phenomena. Here also we get the neighbourhood symptoms as in the chromophobe but rarely symptoms of pressure over the diencephalon. Adenoma before puberty means gigantism whereas such a lesion after the union of the epiphyses produces acromegaly, a picture accurately described by Pierre Marie in 1886. Acromegaly is associated with prognathism, thick bony prominences over zygoma and supra-orbital ridge, thick lips and nose, no apposition of the upper and lower sets of teeth, a kyphosis, big ugly spade like hands and feet due to skeletal overgrowth, a thick coarse skin with excessive perspiration often giving a disagreeable odour, coarse abundant hair, elevated basal metabolic rate and decreased sugar tolerance. Sex changes are diminution of libido in the male and amenorrhoea and sterility in the female just as in the hypo-pituitarism of chromophobe adenoma. After hyper-pituitarism for long,

consequent on continued pressure of the neoplasm on the residual glandular tissue, a picture of hypopituitarism supervenes in the later stages.

In **CHROMOPHIL ADENOMA**, cystic changes are frequent and there are eosinophilic cells with *alpha* granules, voluminous cytoplasm with the cellular arrangement of the strumous variety. **MIXED TUMOURS** of the pituitary present a mixed structure and the clinical picture is one of dyspituitarism. **PITUITARY CARCINOMA** is an adenocarcinoma, disseminates extensively and the cells are arranged from alveolar pattern to densely packed masses of cells with rounded nuclei, of heavy chromatin and well marked mitotic activity. (Fig. 7.)



Fig. 7.

Pituitary Epithelioma Rathke's Pouch.

**Craniopharyngiomata** form 5.1% in Cushing's series. There were 4 suprasellar tumours out of 59 in the present series but it is not known how many were hypophyseal duct tumours. Of the 4 suprasellar tumours, one was a glioma, and one meningioma. Craniopharyngioma occurs high up towards the stalk being a congenital cyst arising from remnants of Rathke's pouch. Mott first suggested such an origin in 1899. Erdheim in 1904 established the essential characters of this neoplasm. Duffy in 1920 collected 52 from the literature and added 5 of his own and divided the craniopharyngiomata into 3 groups: (1) Benign papillary cysts, (2) Calcified or uncalcified adamantinoma — usually cystic and (3) rare malignant type. The common variety is essen-

tially cystic and hence the mention of suprasellar cyst is synonymous with a craniopharyngioma. There is a slight enlargement of the sella and there are flocculent areas of calcification in the suprapituitary region.

The structure is an epithelial tumour with cyst formation. The fluid has a colour varying from yellow to dark green and contains cholestrin crystals.

*Clinically* one sees the condition in childhood and adolescents, though some are met with in adult life. The symptoms are neighbourhood phenomena, hypopituitarism and often those of pressure and invasion of the third ventricle.

*Treatment* consists of exposure of the cysts by the transfrontal route and incision and evacuation of the contents. Removal is so often impossible because it is surrounded by a tangle of vessels of the circle of Willis.

**Meningioma** is a tumour of adult life, commonest between 35 and 55. Cleland and Schmidt in 1903 first suggested that this tumour was derived from arachnoid. In 1907 Spiller pointed out that trauma plays an important part. Cushing and Weed showed in 1915 that these tumours arise from specialised mesothelial cells — meningocytes — capping the arachnoidal villi which are seen in association with intracranial venous sinuses. The site of election for these tumours is the frontoparietal — near the superior longitudinal sinus. Others are located down the convex surface along the cerebral veins, the fissure of Sylvius, olfactory groove and suprasellar regions. The parasagittal location accounts for one in every four. In the series of 10 meningiomata reported here, 3 were parasagittal, 2 frontal, 1 parietal, 1 temporal, 1 occipital and 1 sub-tentorial. In one, location was not mentioned.

The tumour is a dark red or brown mass when fresh, is well capsulated and, if involving bone, produces a bleeding elevation on the interior and exterior of bone when seen fresh. Bony tumefactions may occur some

times before any evidence of intracranial neoplasm. Penfield and Cushing were the first to draw attention to this special feature. There are usually large vessels all round the tumour. Rarely however there may be very little vascularity and sometimes in its substance a concentric laminated calcification may be found. This variety is called a psammoma. The tumour pushes aside brain tissue and indents it, often deeply, yet it never invades the brain. (Fig. 8.)

*Microscopically*, it is composed of elongated spindle cells, resembling fibroblasts, and the cells commonly have a whorled appearance often around a blood vessel. (Fig. 9.)

Bone involvement is probably along the Haversian canals. In a radiogram diploic

vessels are seen enlarged and abundant, erosion of bone is evident at places and what specially is noticeable is a new bone formation perpendicular to the skull surface. This is pathognomonic of a meningioma. (Figs. 10, 11 & 12.)

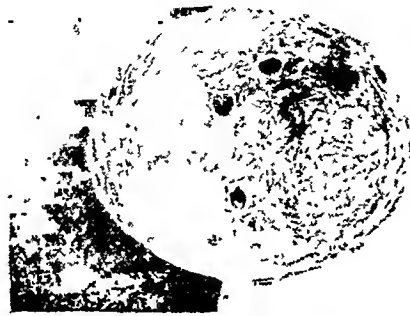


Fig 10.  
Meningioma Skull Changes



Fig. 8.  
Meningioma Brain.



Fig 11  
Meningioma Skull Changes.



Fig. 9.  
Meningioma.



Fig. 12.  
Meningioma Skull Changes.



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nerve fibres are engulfed in the tumour. An important feature is the frequent presence of an arachnoid cyst on the posterior surface of the tumour — this cyst must not be mistaken for the tumour proper which is underneath. (Fig. 13.)

*Microscopically*, there is a characteristic tendency for the nuclei to lie parallel to each other to form a sort of palisade. (Fig. 14.)



Fig. 14.  
Neurilemmoma.

*Treatment*: Because of location, adhesion to pons and the surrounding tangle of vessels we are up against a difficult surgical problem with a mortality of from 67 to 87 per cent prior to 1930. Cushing brought it down to 11 per cent and he advised only intra-capsular enucleation. Walter Dandy in 1925 described the procedure for complete removal and in 1934 he introduced the unilateral approach greatly simplifying the procedure. Later on he made the operation further easy by removing the outer cap of the cerebellum before beginning the extirpation of the tumour. First enucleate the tumour thoroughly from inside the capsule and then with all care do a painstaking removal of all capsule from the brain stem. With partial removal only, hydrocephalus is not completely relieved, mortality is therefore higher and recurrence likely. Dandy gives a 3% mortality in his series of the radically treated patients.

*Result*: If the capsule is also removed, the outlook of the patient is excellent. Even otherwise life with comfort is sure, with good vision, though with permanent deafness. A certain amount of unsteadiness and not uncommonly seventh nerve palsy may result.

*Granulomata* account for 3% of tumours in Cushing's series. They are included among intracranial tumours because the neurological picture is identical with that of tumour. Tuberculomata commonly occur in children in whom the common site of occurrence is the cerebellum. In this series there were four instances of tuberculomata out of 59 identified tumours — a rather high incidence. Two of these four were in the cerebrum. One of the personal cases of cerebral



Fig 15.  
Tuberculoma Cerebrum.

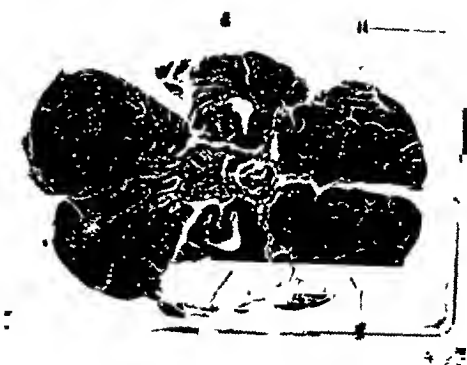


Fig. 16.  
Tuberculoma Cerebellum.

tuberculoma operated upon survived the operation but died three months later from tubercular meningitis. If the diagnosis of tuberculoma is definite, operation is not advised because of the risk of tubercular meningitis a few months following the operation. But now with the streptomycin umbrella, the outlook may change. (Figs. 15, 16 & 17.)

Cholesteatomata are tumours congenital in origin and are to be found at the base of the brain. At the K.E.M. Hospital in Bombay we had two instances of cholesteatomata which are not included in this series. (Fig. 18.)

### DIAGNOSIS

Early diagnosis is most essential and a pre-requisite for good operative results.

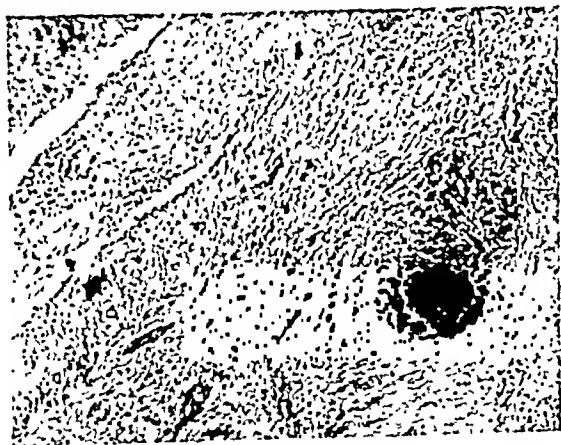


Fig. 17.  
Tuberculoma.

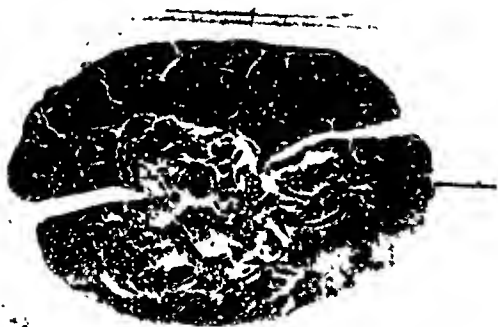


Fig. 18.  
Cholesteatoma.

50% of the tumours are diagnosable clinically by a neurological examination. Another 15% by careful radiography; but the residuum of 35% which were elusive to localisation can now be located with precision after the epoch making introduction of ventriculography by Dandy in 1918. Details pertaining to clinical features of tumours in various situations, the bizarre types of visual disturbance they produce and the various diagnostic investigatory methods used are not discussed as Dr. Cooper is to deal in detail with this aspect of the subject.

### TREATMENT

There is only one treatment for all brain tumours and that is operation with complete extirpation when possible. Meningiomata and astrocytomatous cysts are most suitable for this procedure.

Suitable osteoplastic flaps are employed for all supratentorial tumours and the tumour region is exposed and appropriately treated. In subtentorial tumours, suboccipital craniectomy is done.

30% to 40% of tumour patients may be permanently relieved or cured by properly instituted surgical measures. Another 25% may be alleviated for a considerable period from the discomfort arising from intracranial hypertension, with preservation of vision which is socially and economically of the highest importance. Great patience in the delicate handling of tissues, minute attention to detail and well organised teamwork are all essential in neuro-surgical procedures. An operation for tumour removal may extend for well over 6 hours. In addition to the laborious process of tumour removal the operative field must be left perfectly dry: this itself is a long and tedious process and is attained by employing saline, cottonoid pledgets, suction, diathermy, muscle graft, and "gelfoam" or "oxycel". Lastly but not the least a careful time consuming closure of wound in layers is essential. This generally means that it is just possible to do one operation in the day.

A review of 19 personal cases is interesting and instructive. 16 of them were from K.E.M. Hospital and 3 were from the private clinic. They were operated upon 22 times which includes 3 cases which were operated on twice. Only 6 out of 19 have survived the operation.

An analysis of the 6 survivals shows the following :—

In 2 cases who are living no tumour was found or removed at operation. Suitable decompression was carried out. One was diagnosed as pituitary tumour and the other as cerebellar. Both have had improvement in vision.

One case which was operated upon as a fronto-parietal tumour turned out to be having an extensive subdural haemorrhage. He did very well.

Another which was operated upon as a cerebral tumour in a woman in the parietal region turned out to be a tuberculoma. She died three months later from tubercular meningitis.

One case proved to be an astrocytoma in the parietal region, did very well and recovered from her hemiplegia and was free from epileptic fits. She died 13 months later from pneumonia.

One case was a meningioma in the frontal region and is living three years after operation and is reported perfectly well upto the present time.

The story as can be gathered from this small personal series is not a happy one, in spite of the few stray bright spots. With dogged perseverance and better organisation, better results can be achieved. In the realisation of this objective, the following points are stressed to change the outlook in this aspect of surgery.

1. Careful note-taking, recording and follow-up system have to be developed.

2. Assignment of separate operation theatres (a) with complete equipment for diagnosis including electro-encephalography

- (b) a complete equipment for undertaking operative procedure on the skull and brain and
- (c) with equipment of separate x-ray diagnostic unit with a liberal supply of films.

3. Regular well-organised blood transfusion service.

4. Development of a team including nursing service, for the theatre and for the wards.

5. It is observed that most of the cases of cerebral tumours come to light when they seek the advice of an ophthalmic surgeon for failed or failing vision. Most often it is for blindness that they go to the eye surgeon. In such a state, operative procedure will be valueless except for relieving the tension inside the skull. Even though the tumour is removable, the recovery of sight is problematical. Earlier symptoms of cerebral tumours have been missed due to paucity of good neuro-physicians. They, with better understanding of neuro-physiology, pathology and benefits of modern surgery could stimulate surgeons to develop the technique and the organisation to solve the problems of disease of the brain and the spinal cord. It is stated that Victor Horsley was stimulated to attack the spinal cord by Gowers. If only our physicians can emulate the example of Gowers, it may boldly be stated that many budding Victor Horsleys are available in India.

6. The outlook of neuro-surgery can be summed up in three words "blood, sweat and tears". It is not remunerative for a surgeon to live on this speciality. It was so all the world over in the earlier stages of the development of this surgery. It is therefore necessary in the present state of development of neuro-surgery in our country to make it a whole time job for all concerned working in this team. Several mental cases in mental hospitals can be rehabilitated by investigation. It may be that some of them have cerebral tumours and an investigation may throw some light on this question and perhaps some of these can be salvaged from eternal mental depravity. It therefore

requires a bold policy and it is hoped that the object of this paper will be gained if the statesmen of our country, the physicians and the surgeons evolve a scheme to be worthy of our present national status.

I have to express my thanks to the Dean and my medical and surgical colleagues of King Edward Memorial Hospital, Bombay, for letting me use all the material for study. I have to thank the Professor of Pathology for the use of the specimens and slides in connection with the pathology of intracranial tumours. My special thanks are due to Dr. Adhia, an old house surgeon of mine, but now a colleague on the Honorary Staff, K. E. M. Hospital, who has devoted a lot of time and energy to a careful study and tabulation of the clinical and pathological material. Drs. Vaze and Shah have both helped him in this collection and tabulation of material. Dr. Karmarkar who is associated with me has given me all assistance in both the clinical study and operative treatment of my small series of intracranial tumours. To him my thanks are due.

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## BRAIN TUMOURS\*

by R. N. COOPER, *Bombay.*

Harvey Cushing's monumental work has made it possible to recognise brain tumours sufficiently early and to treat them surgically with considerable safety and success. It is also possible to give an assurance of a complete cure in some cases and a marked relief from symptoms for an appreciable period of time in others.

Medical practitioners still live in the pre-Cushing era and wait for a fully fledged picture of headache, vomiting and choked discs before turning the case over to a surgeon for treatment of an intracranial lesion. The delay arises from a non-appreciation of the fact, that not even one of these classical signs may be present in many a brain tumour in its early stages of development. In the light of our present knowledge it is possible for a surgeon confronted with a problem of intracranial disease, to be reasonably sure of the presence of a tumour, its exact location and its pathological nature.

Some parts of the brain have such a highly specialised function that even a small area known as area 19 of Brodmann (Figs. 18 & 19) in the occipital lobe of the major side (usually the left side in right handed people) is concerned with the function of revisualization or the power to recall to mind images formerly seen. Nielsen records the case of a physician who suffered from this defect in so far as he could not recall the streets of his own city, his patients, their homes etc., but if placed in his car he could recognise all he saw. He could examine, diagnose and prescribe. A small tumour in the left occipital lobe was correctly diagnosed and removed.

Many tumours have a tendency to occur characteristically in certain locations or at a

certain age in the life of a patient. These produce a group of symptoms due to involvement of neighbouring structures resulting in certain well recognised syndromes, such as the syndrome of tumours of the cerebellopontine angle, the syndrome of pituitary adenomas etc.

Some time the character of the tumour can be judged from its location. Thus a tumour of the cerebellopontine angle is most likely to be a perineural fibroblastoma. A growth of the pons, especially in a child will turn out to be a tuberculoma. In our series we have found that in the case of children it is always best to consider tuberculoma as the first diagnosis in suspected intra-cranial lesions.

Mid-cerebellar tumours in children will prove to be medulloblastomas. A tumour in the lateral lobe of the cerebellum in a child will prove to be an astrocytoma with a cyst formation.

The life history of a tumour case, or in other words the rate of progress of the tumour also gives an indication of the pathological nature of the tumour. Thus a glioblastoma multiforme is characterized by symptoms of a rapid onset, such as sudden coma or paralysis. In fact such a dramatic onset is suggestive of a vascular lesion of the brain. Should the patient survive this primary insult there is a slow recovery with persistent headache and with mental dullness which lightens and deepens intermittently. A high degree of oedema of the brain is associated with such tumours. This increases the intra-cranial pressure rapidly, producing a high grade papilledema with retinal haemorrhages. On the other hand a cortical meningioma is slow in onset, insidious in its progress with many periods during which there appears a recession of symptoms. The lucid period with freedom from headache or any focal irritative symp-

\* A paper read at the X Annual Conference of the Association of Surgeons of India during Dec., 1948.

tom in such a case may be sufficiently long to mislead the clinician who is inclined to believe that the symptoms of intracranial tumour should be continuously progressive.

Thus it is quite clear that intracranial tumours cannot be discussed as a whole in a paper of this nature. It is proposed to concentrate on the subject of localisation of brain tumours. To shorten the paper, I wish to leave out of account such well defined syndromes as those of (1) tumours of the cerebello-pontine angle, (2) pituitary adenomas, (3) supra-sellar tumours, (4) parasagittal meningioma of the vertex, (5) olfactory groove meningioma and (6) glioma of the optic nerve or chiasma. These different syndromes are very well described in text books. When such a syndrome is met with in practice, the diagnosis is sufficiently clear.

Unfortunately, a large number of tumours cannot be recognised so readily. However by being alive to the possibility of a brain tumour one can make a shrewd guess even in the early stages. Tumours may reveal themselves by either general or focal symptoms. The general symptoms are covered by the triad—headache, vomiting and papilloedema. In addition, at some stage, a blunting of mental alertness occurs, along with impairment of memory and power of attention. Epileptiform fits may occur at any stage. Focal symptoms naturally vary with the location of the tumour and will be discussed later.

In many cases of tumour, these focal and general symptoms are of a progressive nature. Briefly stated the progressive loss of neurological function is a challenge to the physician to prove that a tumour does not exist.

To meet this challenge, a very careful history taking, recording the onset of symptoms and signs in a strictly chronological order is necessary. A very thorough neurological investigation along a plan laid down in any text book on neurological diseases is essential. The importance of ascertaining

whether a patient is right or left handed cannot be overemphasised.

Certain additional examinations are necessary such as:—(A) Auscultation and percussion of the head. (B) Retinoscopy and perimetry. (C) Roentgenography of the skull. (D) Pneumography. (E) Electroencephalography. (F) Angiography. (G) Barany tests.

An exhaustive account of the clinical investigations and these additional tests is not possible within the scope of a short paper. Only a few points which help to localise a tumour will be referred to briefly.

(A) *Auscultation* will reveal the presence of an arterial angioma or angiomatous meningioma. A bruit is sometimes heard in cases of cerebellar tumours in children.

Percussion over the skull may elicit a typical cracked-pot sound probably due to a widening of the cranial sutures.

(B) *Retinoscopy*. A primary optic atrophy indicates a direct pressure on the optic nerve or the chiasma as in pituitary tumours or optic nerve gliomas. Papilloedema may be succeeded in a few weeks or months by a secondary optic atrophy which closely resembles the primary atrophy in appearance. Unless correctly interpreted it misleads the clinician.

*Perimetry* or examination of the eyefields gives a very accurate localising information. A couple of illustrations will make this point clear. The field defects produced by tumours pressing on the optic nerve, the chiasma and the tracts are sufficiently distinctive and are represented in Fig. 1 a, b, c, d & e. It is well to realise that fibres carrying visual impulses from the lower and inner quadrants of say the right eye and the lower and outer quadrant of the left eye form a tract which after leaving the chiasma ends in the left external geniculate body. From here it spreads out as part of the optic radiation in graceful curves skirting the descending horn of the lateral ventricle on



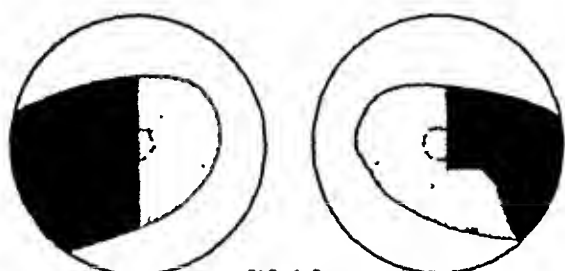


FIG. 1. a.  
BITEMPORAL HEMIANOPIA

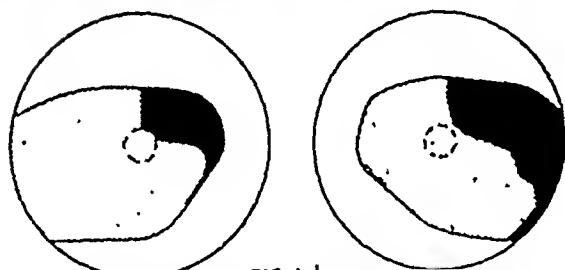


FIG. 1. b.  
EARLY TEMPORO-SPHENOIDAL LESION

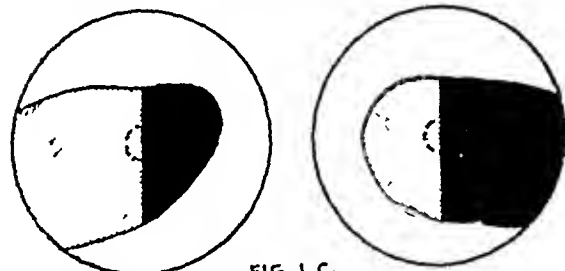


FIG. 1. c.  
LATE TEMPORO-SPHENOIDAL LESION  
(MACULA SPLITTING)

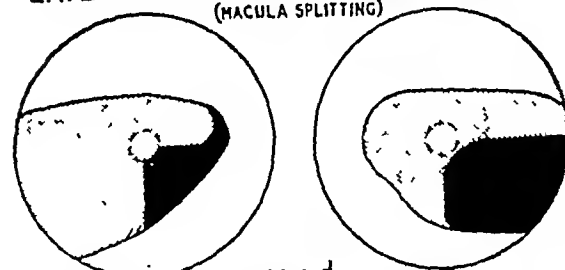


FIG. 1. d.  
PARIETAL LOBE LESION INVOLVING  
DORSAL OR SUPERIOR  
RETINAL FIBRES

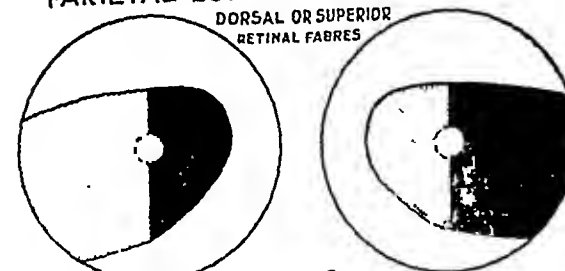


FIG. 1. e.  
OCCIPITAL LOBE LESION (MACULA SPARING)

Fig. 1.

its way to the occipital lobe (Figs. 2 & 3). This loop was first described by Meyer and is known as Meyer's loop. Cushing emphasised the clinical application of this loop. Hence it is also known as Cushing's loop. A tumour in the left temposphenoidal lobe will produce an upper right homonymous quadrantic field defect by exercising pressure on this loop. Later a complete right homonymous hemianopsia will be produced. Such a patient may give a history of bumping into objects on his right side.



Fig. 2.

(C) A routine roentgenological investigation to be really useful, should include two stereoscopic pictures of the skull. The first should be a stereoscopic picture giving the antero-posterior view of the skull and the second the lateral view of the skull with the side on which the lesion is suspected, nearest to the film. Quite a fair percentage of brain tumours show evidence of calcification and the stereoscopic pictures are very helpful in correctly judging the depth of the calcified area. Such stereoscopic roentgenograms will be helpful in a variety of ways.

- (1) The pineal gland shows calcification in about 40 to 60 percent of cases. In an antero-posterior skiagram the pineal shadow, when visible, should be in the mid-line. An expanding lesion in one hemisphere will cause this shadow to shift towards the other side. In a lateral picture, displacement in a vertical plane can be made out. Pinealomas



show evidence of calcification and can thus be identified.

- (2) Local erosions of bone or hypercalcifications are seen in cholesteatomas and meningiomas.
- (3) Enlargement of certain cranial foramina can be made out by special techniques and help to localise tumours at the optic foramen, the internal auditory foramen or the foramen magnum.
- (4) Ballooning of the sella turcica or the disappearance of its inferior margin helps to distinguish pituitary adenomas.
- (5) Certain tumours show evidence of calcification such as astrocytoma fibrillare, neuroblastoma, oligodendroglioma, Rathke's pouch tumours, haemangioblastomas, pinealomas, choroid plexus tumours, old haematomas, tuberculomas and aneurysms.
- (6) Widening of the sutures is characteristically shown in cerebellar tumours of children.
- (7) Localised areas showing a network of vascular channels (so called venous lakes) with associated evidence of thickening of bone and spicule formation is characteristic of meningiomas.
- (8) Erosion of the posterior clinoid processes of the sella turcica is seen in all cases of increased intracranial tumours.
- (9) If increased intracranial pressure has existed for at least six months a beaten-silver appearance of the skull is produced with widening of sutures. This appearance is produced by the thinning of the bone in areas corresponding to the crests of the cerebral convolutions. This appearance is also known as "digitations". It is important to note that these "digitations" are a nor-

mal feature in many skulls of young children. These digitations are pronounced in cases of congenital synostosis of the skull. The absence of widening of the sutures in such a case rules out the possibility of an intra-cranial lesion.

- (10) Occasionally the calcified margin of the falx cerebri is shown up in a skiagram. Normally it appears as a white streak in the mid-line. Should a tumour be present in one hemisphere the falx is pushed away to the other side and appears to have a concavity on the side of the lesion.

(D) *Pneumography* includes both ventriculography and encephalography.

Ventriculography is more useful in the localization of brain tumours and also safer than encephalography. The technique of these procedures need not be considered.

In 7% of encephalograms the ventricles are not visualized even though they can be demonstrated later by ventriculography. Encephalography however shows up the sulci of the brain (Fig. 4). The displacement of these sulci sometimes reveals the location of a tumour even in the absence of ventricular shadows. Widened and deepened appearance of sulci suggests cerebral atrophy.

It is very important to be able to visualise the ventricular system in relation to the



Fig. 4.

bony markings of the skull (Figs. 5 and 6). Penfield has shown that even under normal condition the posterior horn of the lateral ventricle varies in size and may even be absent.

In an antero-posterior skiagram the appearance of the normal anterior horns with the septum pellucidum is compared to a butterfly (Fig. 6 & 7).

Some of the fundamental principles in the interpretation of ventriculograms with a view to localise a tumour, may be briefly discussed.

Deviations from the normal are either symmetrical or asymmetrical.

In *symmetrical* dilatations of the lateral ventricles (Fig. 8) the block is either in the third ventricle or behind it. As the third ventricle does not often show up even when unobstructed, the exact location of the

tumour becomes difficult. Elsberg and Silbert state that cerebellar tumours produce a greater dilatation of the anterior horns as compared to the others. A large cerebellar tumour may however distort the posterior horn of the lateral ventricle.

In third ventricle tumours both the lateral ventricles will be dilated with a partial or complete obliteration of the third ventricles (Figs. 9 & 10).

A tumour obstructing the aqueductus will cause a dilatation of both the lateral ventricles as also the third. Tumours of the



Fig. 5.

- |                            |                          |
|----------------------------|--------------------------|
| C.S.—Callosal Sulcus       | P.—Paracentral Sulcus    |
| G.—Genu of Corpus Callosum | T.C.—Tentorium Cerebelli |
| Cing.—Cingulate Sulcus     | S.A.—Subarachnoid Space  |

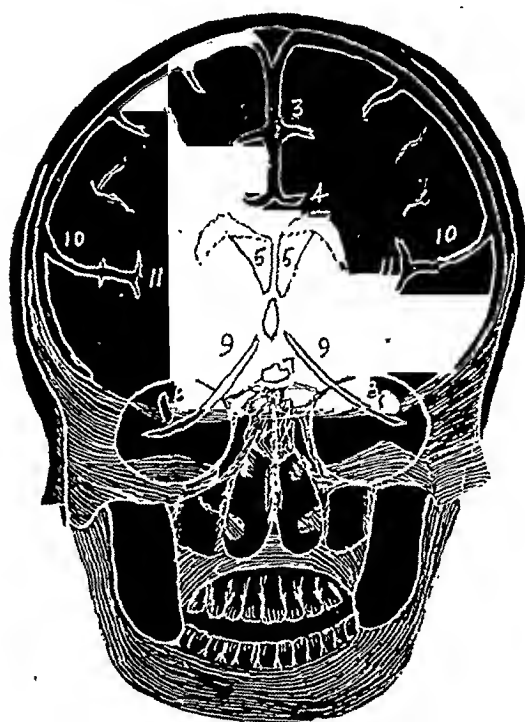


Fig. 6.

- |  |                                       |
|--|---------------------------------------|
| 1. Subarachnoid Space                                      | 6. Third Ventricle                    |
| 2. Falx Cerebri  | 7. Position of 4th Ventricle          |
| 3. Cingulate Sulcus  | 8. Temporal horn of Lateral Ventricle |
| 4. Callosal Sulcus   | 9. Tentorium Cerebelli                |
| 5. Lateral Ventricle with the septum pellucidum in between | 10. Sylvian Sulcus                    |
|  | 11. Island of Reil                    |

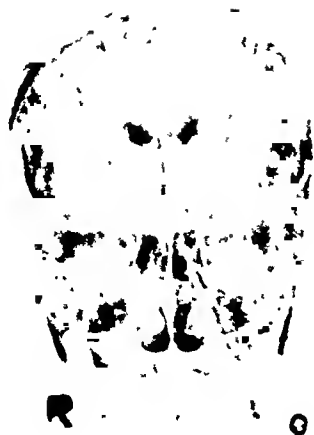


Fig. 7.



Fig. 8.

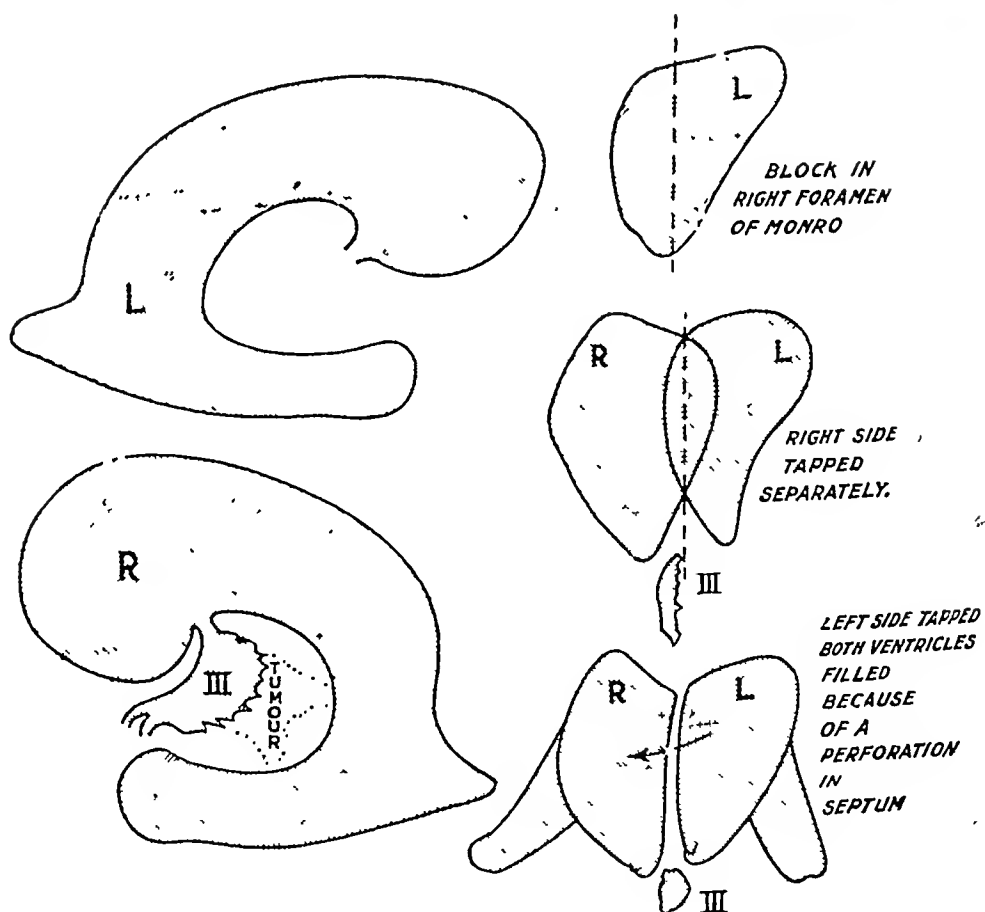


Fig. 9.

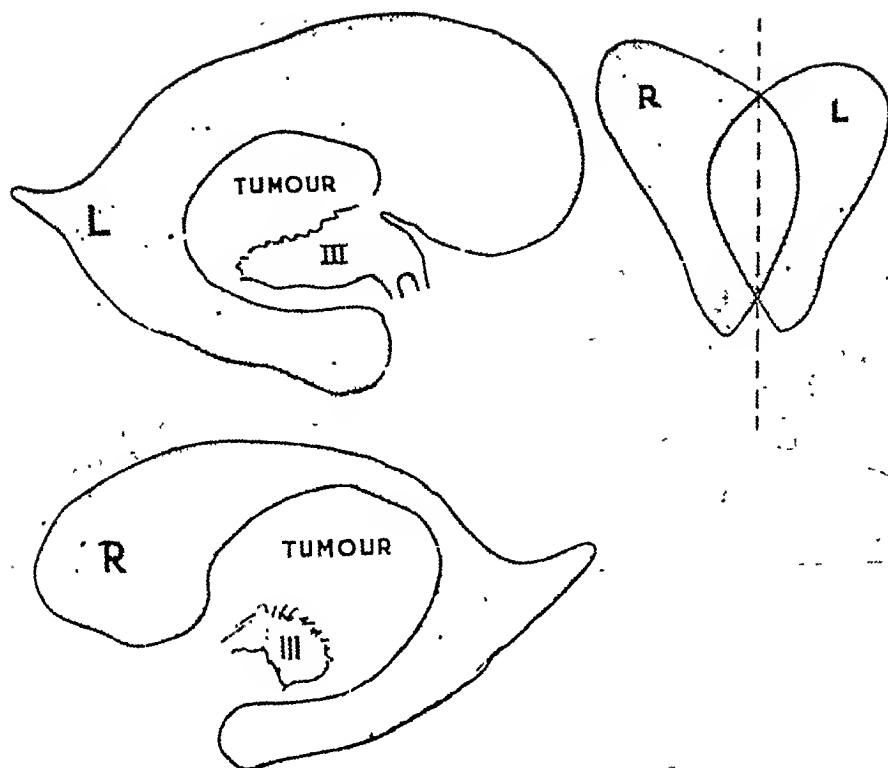


Fig. 10.

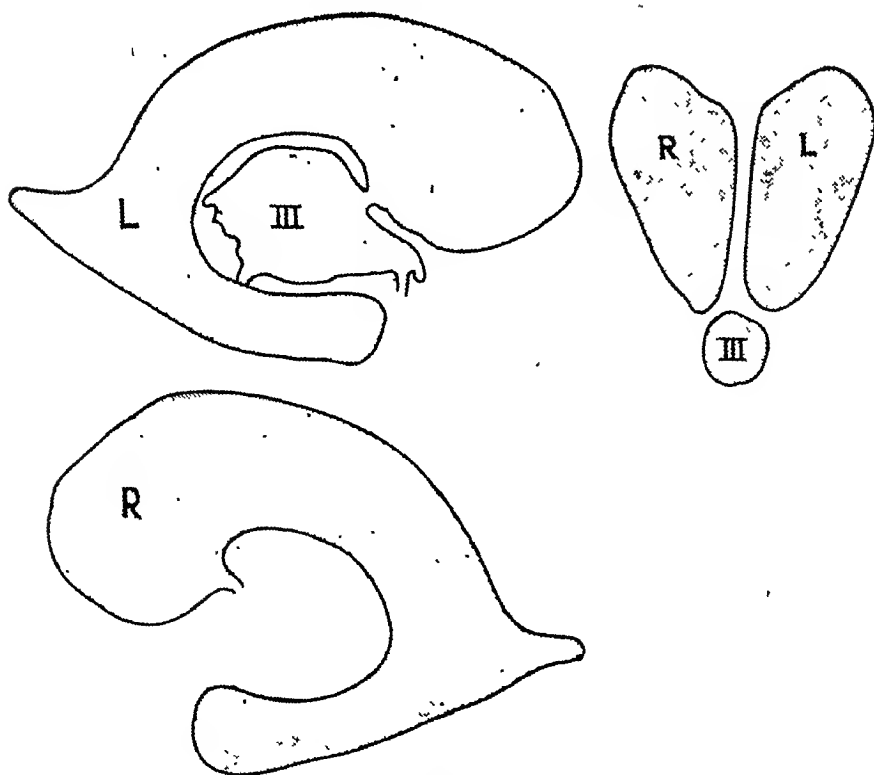


Fig. 11.



Fig. 12.



Fig. 13.

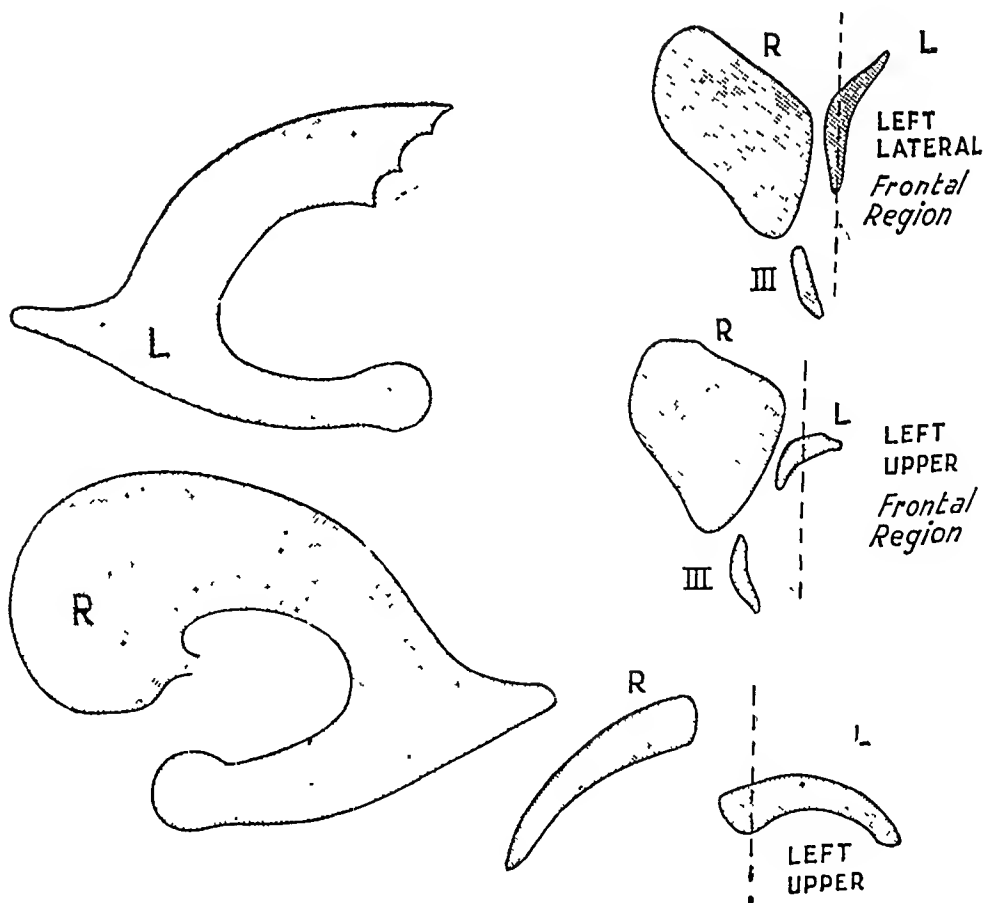


Fig. 14.

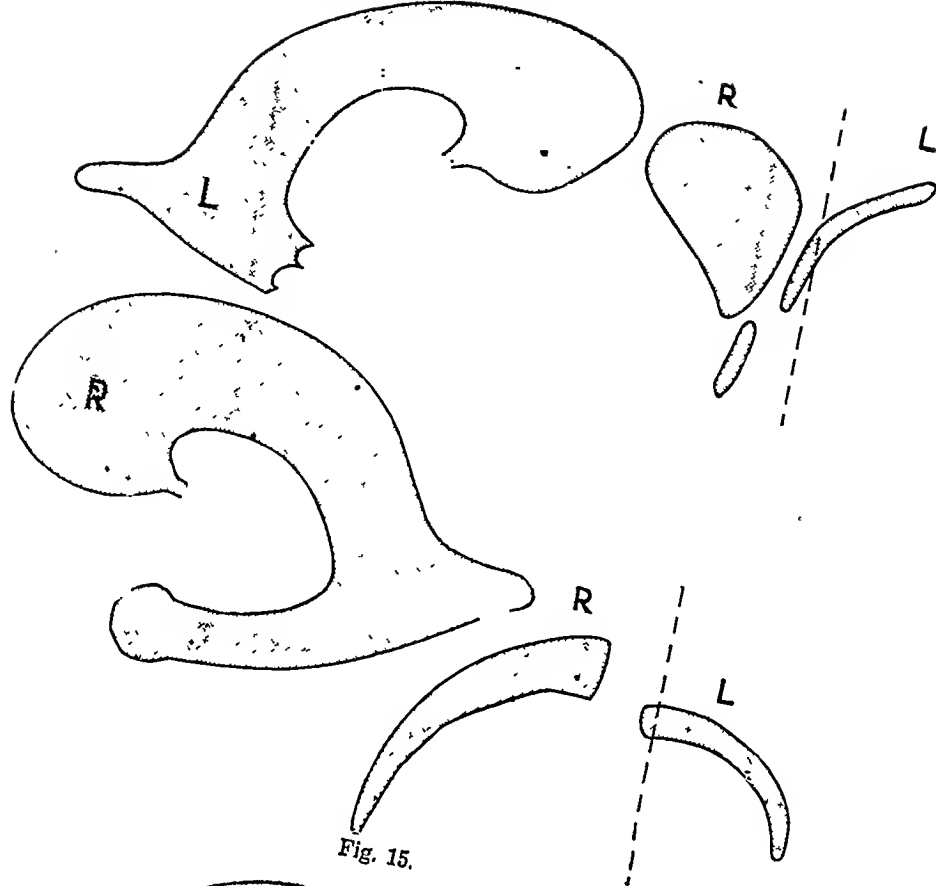


Fig. 15.

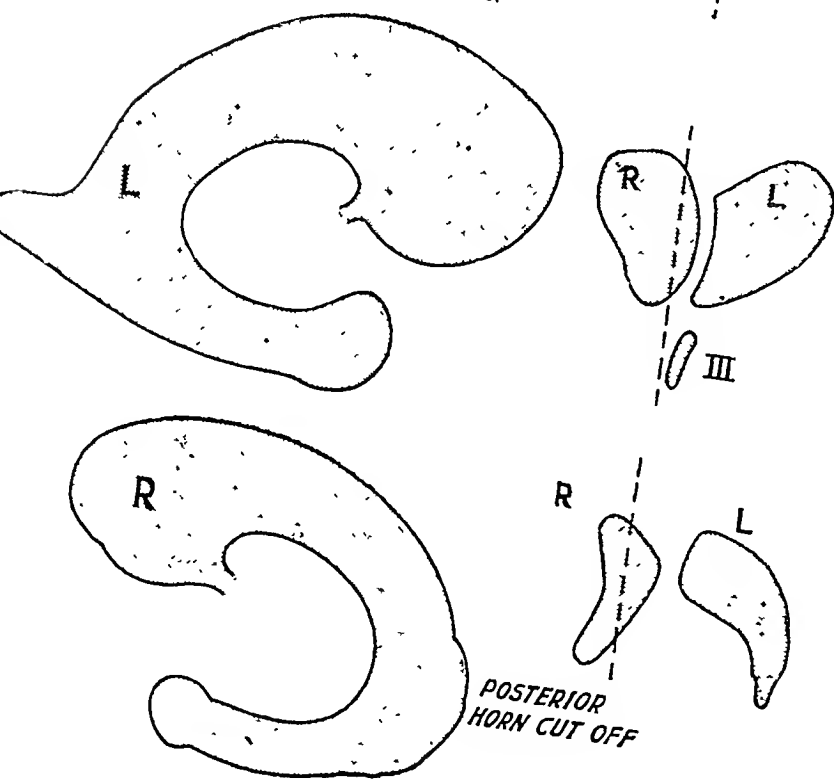


Fig. 16.



vermis of the cerebellum will show an internal hydrocephalus of all the ventricles except the fourth (Fig. 11).

*Asymmetrical dilatation* of the lateral ventricles strongly suggests a lesion in the cerebrum (Fig. 12). The earliest enlargement of the lateral ventricle is shown in an antero-posterior skiagram by the rounded appearance of the anterior horn, which alters the typical butterfly appearance already referred to.

A tumour in one hemisphere lying lateral to the ventricle may obliterate the whole or part of a ventricle and also push it over to the opposite side (Fig. 13). As seen in an antero-posterior view, the anterior horn of the ventricle on the affected side may be partially or totally obliterated and the opposite ventricle may show dilatation. The mid-line septum representing the septum pellucidum shows a shift to the opposite side with alteration in its contour. The third ventricle becomes displaced beyond the mid-line.

In a frontal lobe tumour the anterior horn will be encroached upon and displaced downwards or in any other direction (Fig. 14). In temporal lobe tumours the

inferior horn is affected (Fig. 15). In parietal lobe tumours the body and posterior horn will show up a defect. An occipital lobe tumour will displace the posterior horn (Fig. 16). A characteristic appearance of the ventriculogram in a cyst of the septum pellucidum is presented (Fig. 17).

(E) *Electro-encephalography* will not be discussed as personal experience with this procedure is very little.

(F) *Angiography*. For want of the proper material for visualization of cerebral vessels this method has not been tried personally.

(G) *Barany's tests* consist in stimulating the semi-circular canals by syringing out each ear with cold water at about 20°C and recording the subjective and objective responses obtained. These help materially to determine whether the tumour is at the cerebello-pontine angle or supra-tentorial (occipital lobe) or infra-tentorial. The subjective responses are vertigo, nausea and vomiting; the objective ones are nystagmus, and past-pointing.

In cerebello-pontine tumour no responses are obtained from the semicircular canal on the side of the tumour.

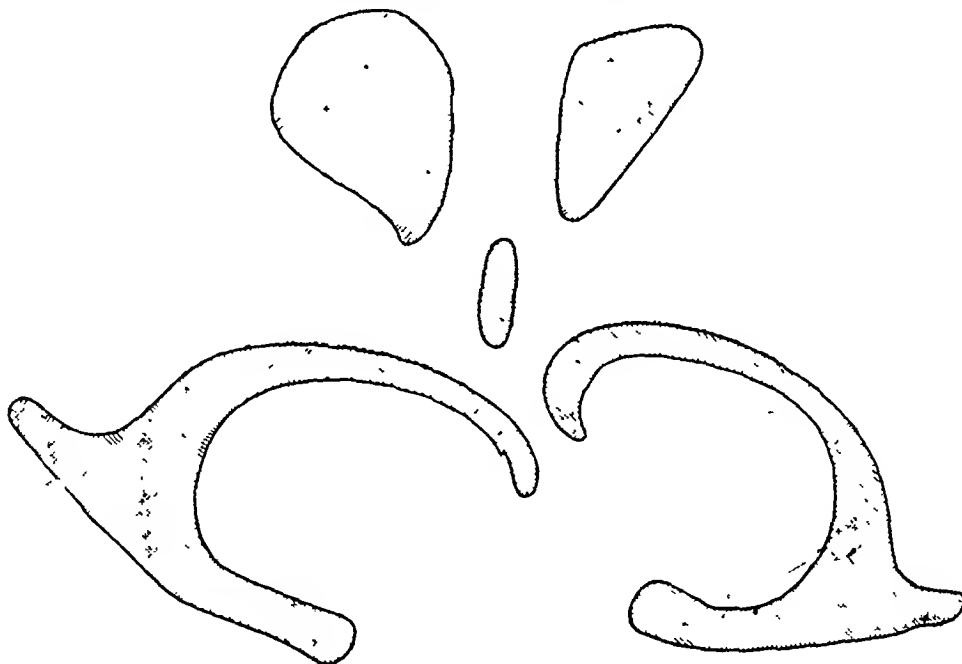


Fig. 17.

In posterior fossa tumours—subjective responses are absent or diseased and in lesions above the tentorium subjective responses are greatly exaggerated.

These accessory methods of examination are very helpful but prime importance must be attached to the neurological signs resulting from either the stimulation of any part of the brain or its dysfunction. The localising signs from these points of view will be briefly discussed in respect of, the four main lobes of the cerebrum and the cerebellum. It may be stated at the outset that in certain cases the closest study may fail to show the location of the tumour. Tumours located in the silent areas, especially the right temporal and certain parts of the right frontal (in right handed persons) are often unlocalizable. As the tumour grows larger false localizing symptoms result from pressure on adjacent or distant parts. Hence has arisen Brun's aphorism that "localization of a tumour on the basis of focal symptoms is the more certain, the less marked the general symptoms are, that is, the smaller the tumour." It may further be added that the value of localizing symptoms are the greater, the earlier they appear in the course of the disease, and the less to be relied upon in the late stage of the disease.

**FRONTAL LOBE:** Early manifestations are referable to intellect, emotion and personality when tumour is in the premotor cortex. The following symptoms may be enumerated:—(1) Impairment of memory for recent events, (2) difficulty in concentration, (3) emotional instability, (4) pathological jocosity, (5) impairment of judgment, (6) changes in personality, and (7) anti-social tendencies.

The other parts of the frontal lobe have well-defined functions and will be referred to by numbers as Brodmann areas (Figs. 18 & 19).

Thus area 4 of Brodmann is the pre-central motor cortex. A tumour in this region may produce a localized clonic seizure of some set of muscles followed by

some paresis of voluntary movements. A localized convulsion may pass into a typical Jacksonian epilepsy. When the growth is subcortical, paralysis may be the first sign and the fits may appear later when the cortex is involved. When the premotor frontal area (Brodmann 6) is involved the performance of skilled movements is lost.

An irritative lesion in area 6 causes the return of the grasp reflex (which is present normally in an infant) on the contralateral side. It is a reflex of great localising value even when the patient is comatose.

Area 44 is the well known Broca's convolution. The less said the better.

When area 8 is irritated, the eyes turn to the opposite side. If this area is destroyed the patient is unable to move the eyes to the opposite side and keeps looking to the side of the lesion.

Disturbances of co-ordination of muscular movements of equilibrium, have often been observed in frontal lobe tumours. The fronto-cerebellar connections *via* the red nucleus and the Deiter's nucleus will serve to explain this phenomenon. Thus a tumour in the left frontal lobe will bring about cerebellar ataxia of the right limbs with a tendency to fall backwards. Barany's vestibular test will show absence of cerebellar involvement. Again adiadokokinesis is absent in a truly frontal lesion.

Tumours occurring on the under surface of the frontal lobe may involve the optic and the olfactory nerves with production of characteristic defects.

**PARIETAL LOBE:** A tumour in the post-central or Brodmann areas 1, 2 and 3 will cause, in a fully fledged case, sensory Jacksonian epilepsy, cortical sensory disturbances and asteregnosis in the contralateral limbs. The most potent centre for asteregnosis is the central portion of the post-central convolution where the fingers are represented.

Asteregnosis is also caused by lesions of the superior parietal lobule. Probably the sensory perceptions in the post-central con-

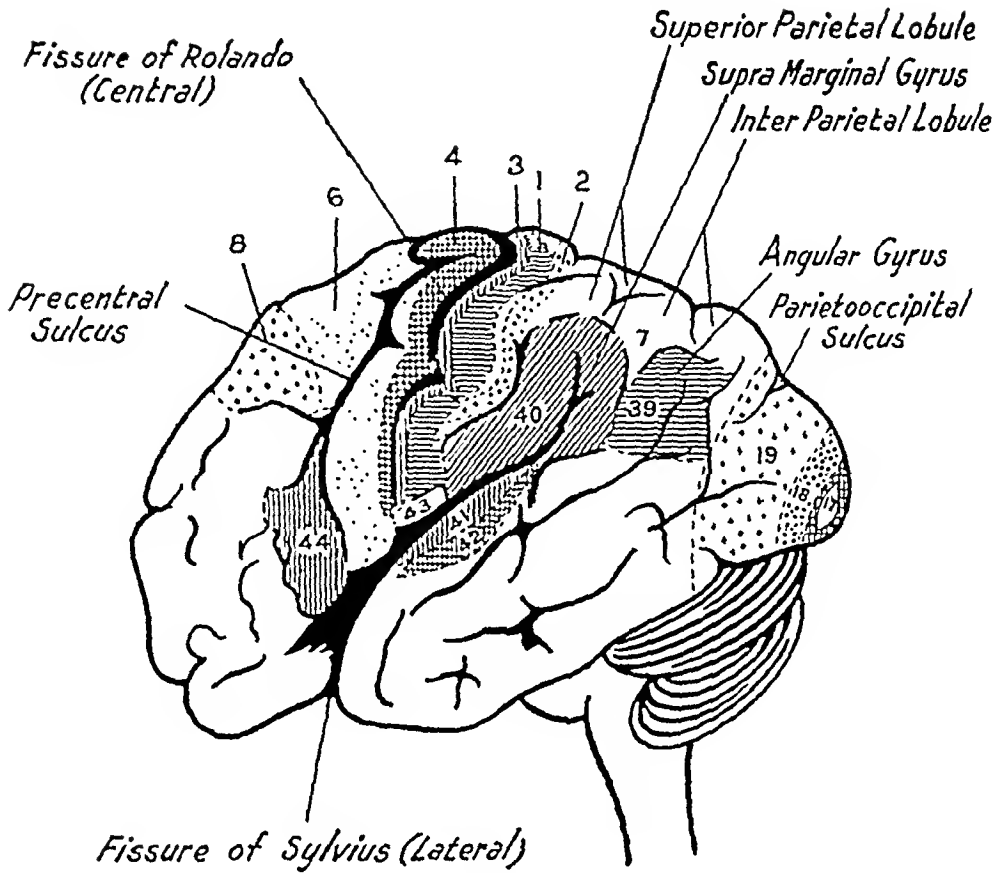


Fig. 18.

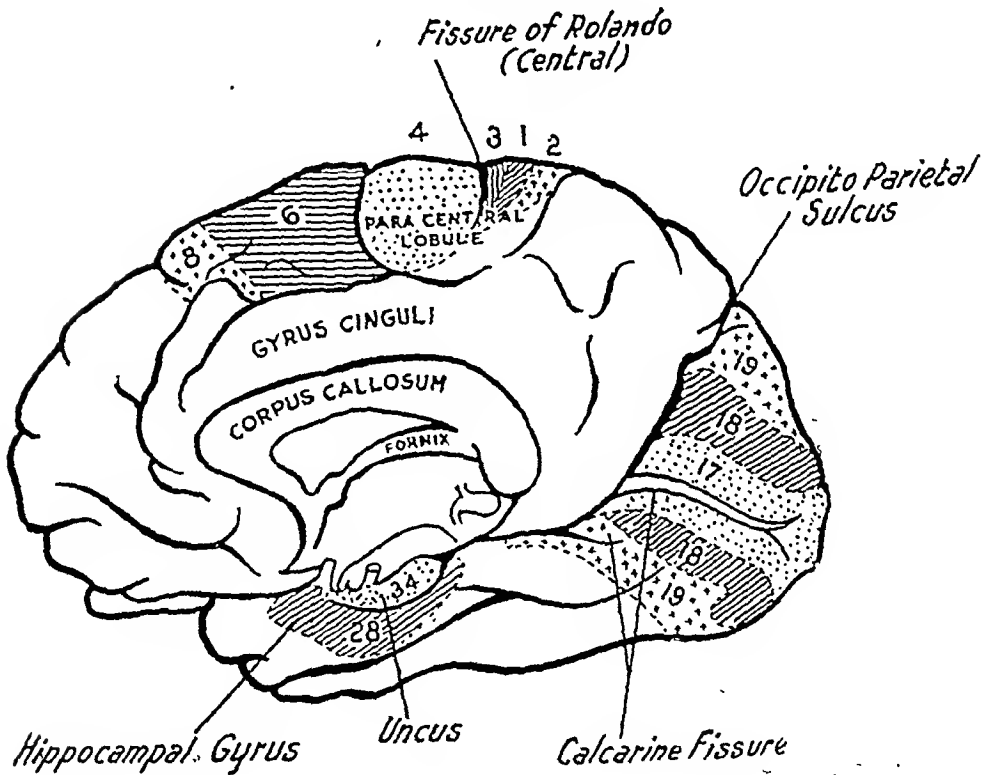


Fig. 19.

volution are elaborated in the superior parietal lobule (part of area 7). The superior parietal lobule is concerned with psychic elaborations as well. A lesion of the occipital lobe destroying the superior parietal lobule causes generalized autotopagnosia; that is the patient loses power to identify his body or parts of it. He cannot tell laterality.

On the minor side (right side in right handed people) a lesion between the thalamus and the supra marginal gyrus (area 40) causes the patient to have marked psychic sensory loss referable to the minor (usually left) limb. Periodic amnesia for the left limb may appear. The patient may use his limbs at times and forget them on occasions. He may bathe the right side and forget the left or dress the right side and forget the left.

The parietal lobe includes the angular (39) and the supra-marginal gyri (area 40). These convolutions on the left side (for right handed persons) are the supposed seats of visual speech. The destruction of these areas leads to word-blindness. This is an inability to understand printed or written language even though the individual letters or even words can be seen by the patient. It may be stated for the patient that he has forgotten his alphabet.

In addition there may be an involvement of the optic radiations as they pass through the parietal lobe. A deeply placed tumour will produce a contralateral homonymous visual defect involving the lower quadrant. Pupillary reactions remain intact.

**TEMPORAL LOBE:** The olfactory receptive centre is located in the uncus and adjacent portions of the hippocampal gyrus of the temporal lobe. Probably the centre for taste is there too, though Forester locates the gustatory area in Brodmann area 43.

Lesions which affect the uncinate gyrus give rise to unpleasant olfactory aura such as that of stale blood or rotten eggs. Such attacks have been known as "uncinate gyrus fits". As the fit starts the patient usually smacks and licks his lips. Curiously

transient mental symptoms first designated as dreamy states by Hughling Jackson, often accompany these olfactory and gustatory sensations. The part of optic radiation known as Meyer's loop or Cushing's loop has already been described. The visual field defects already mentioned earlier, are of definite localising value (Fig. 1 a, b, c, d & e). Here the macular vision is also involved. Due to irritation of these optic radiations certain visual hallucinations occur. The hallucinations are of form and person. The patient sees persons and animals moving off to one side as a parade or a theatrical play. Cushing pointed out that these hallucinations appear on the blind side of the field of vision. However Horax has shown that hallucinations may be present without the field defects or precede them. When the lesion is further back, that part of the optic radiation which carries impulses from the superior half of the retina will be pressed upon and a characteristic defect in the visual field is noticed.

The auditory receptive centre is situated in the anterior temporal gyrus which lies buried in the floor of the lateral sulcus (Sylvian fissure). (Areas 41 & 42 of Brodmann). The area for recognition of music is anterior to this in the anterior one half of the superior temporal convolution. These areas receive auditory radiations from the mesial geniculate body. Involvement of the auditory receptive centre leads to a sensory aphasia. In right handed persons the left lobe will be involved. This aphasia is characterized by a loss or impairment of understanding of spoken words and misuse of words, producing some sort of a jargon.

If the anterior part of the superior temporal gyrus is intact, the person in spite of his aural aphasia can recognise and appreciate music.

Enlargement in the size of the tumour leads to increased intracranial pressure which may produce herniation of the temporal pole through the incisura of the tentorium with consequent pressure on some of the cranial nerves. Thus there may be

an absence of corneal reflex, oculo-motor paralysis and ptosis of the lid.

Mental symptoms are common. Memory defects are both for recent and past events through destruction of the auditory speech area and association areas. The patient may be melancholic, silly or childish.

**OCCIPITAL LOBE:** Tumours of the occipital lobe are less common than those of the anterior portions of the brain. These tumours have no distinctive history as a rule. Occipital lobe is concerned both with perception of vision and visual memories. The fibres of the optic radiations from the lateral geniculate body go to the visual cortex on the occipital lobe on the borders of the calcarine fissure (Brodmann 17). The fibres from the lower half of the retina go to the lower lip of the calcarine fissure and those from the upper half to the upper lip. The macular fibres terminate in the occipital pole (Fig. 3). The macula is represented bilaterally in the occipital lobe. Pressure on the occipital portion of the optic radiation will produce a contralateral homonymous hemianopsia in which the macula escapes. Hence it follows that destruction of area 17 does not interfere with accurate perception. The patient can read if he once gets his eyes focussed on the print so long as the occipital pole is intact. Area 17 is not concerned with visual memories. Hence if the cortex of this area is destroyed the patient can still describe scenes observed in the past.

Apart from the primary cortical area for perception of vision (area 17) there are secondary and tertiary cortical areas where visual images are stored. Brodmann areas 18 and 19 serve this purpose. Area 19 which is concerned with revisualization of objects has been referred to earlier in this paper.

Visual hallucinations which occur as the result of the occipital lobe tumours are described by patients as flashes of light, brilliant stars, a rainbow of colours and bright lines in contrast to the visual hallucinations of form and person in irritative lesions of the temporal lobe. Because of these visual

hallucinations of flashes of light associated with headache, occipital lobe lesions have been wrongly diagnosed as cases of migraine.

As the tumour enlarges, the falx cerebri, because of its great depth in this situation, gets displaced more readily, and thus secondarily pulls up the tentorium producing pressure on the veins of Galen. The veins being compressed cause an increased formation of cerebro-spinal fluid. The increase in the intracranial pressure so produced, is evidenced by the choked discs.

As the tumour enlarges, sensory disturbances in the contralateral half of the body appear because of pressure on the post-central gyrus.

Similarly sensory speech area will be affected if the tumour is on the left side (right handed person). Pressure downwards on the tentorium will lead to homolateral cerebellar symptoms. Barany's test is valuable to distinguish between an occipital lobe and a cerebellar lesion.

**THIRD VENTRICLE:** Symptoms of tumours in this region are so varied because of the involvement of neighbouring structures like the hypothalamus, the thalamus, the pituitary gland, the corpora quadrigemina and the pineal body that even a short consideration of the subject is out of the question. Pneumography alone helps to accurately localise the tumour in this region.

**CEREBELLUM:** Tumours of the cerebellum are particularly common in children. In Cushing's series nearly 55 per cent of all brain tumours in children under fifteen years of age were of cerebellar origin. The symptoms are two-fold—those due to cerebellar dysfunction and those due to increased intracranial pressure resulting from blockage to the circulation of cerebro-spinal fluid.

Symptoms arising from increased intracranial tension occur early and overshadow those due to cerebellar dysfunction.

Thus headache is an early symptom and often very severe. It is referred to the

suboccipital region and is accompanied by tenderness in the same region. The muscles may show marked rigidity on the side of the tumour, carrying the occiput to the side of the lesion and the chin in the opposite direction. In young children the head may enlarge calling for a larger hat. The increase in size of the head is brought about by the widening of the cranial sutures. Percussion over such a head gives rise to the so called "cracked-pot" sound. Vomiting and vertigo are present invariably. Vomiting is so insistent that an unsuspecting physician loses invaluable time in investigating the gastro-intestinal tract of the patient. The signs and symptoms arising from cerebellar dysfunction will be just enumerated.

(1) Ataxia. (2) Asynergia. (3) Dysmetria. (4) Tremor. (5) Rebound phenomenon. (6) Adiadochokinesis. (7) Drifting of the extended limb. (8) Station and gait. (9) Nystagmus. (10) Cerebellar fits. (11) Cranial nerve involment. (5th, 6th and 7th). (12) Defective articulation. (13) Altered reflexes. (14) Hypotonia.

Tumours of the cerebellum may involve the vermis or the lateral lobes.

Neoplasms of the vermis are rare. But a medulloblastoma particularly occurs in the region of the vermis. These children in addition to headache and vomiting, have bilateral ataxia, dysmetria, tremor, etc. They have a tendency to fall backwards. Nystagmus is absent.

Neoplasms of the lateral lobe are accompanied by more definite evidence of ataxia, atonia, suboccipital headache and very definite nystagmus.

It may appear from these considerations that the diagnosis of a cerebellar lesion should be easy. This is not so in actual practice. Tumours in the frontal lobe, the occipital lobe and suprasellar region may give rise to secondary cerebellar symptoms. An advanced case of such an origin may lead to an erroneous diagnosis with resulting subtentorial exploration. This mistake can be obviated by strict attention to the

chronological development of symptoms. Cerebellar symptoms, when secondary, usually appear last among the localising signs instead of first, as in primary cerebellar tumours.

The value of Barany's test and pneumography has already been stressed.

As this paper in no sense is meant to be exhaustive, consideration of tumours in many other regions of the brain is omitted.

Localisation of cerebral tumours in the aged is particularly difficult as the mental and other neurological symptoms produced by arterio-sclerosis are intermittent and progressive. Angiography will play an increasing role in the demonstration of pathology of a vascular nature.

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## DISCUSSION—BRAIN TUMOURS

A. E. De Sa (Bombay) said that the commonest space occupying intracranial lesion in the younger age groups in Bombay City is tuberculoma.

In the four year period, 1945-48, out of a total of 6 cases diagnosed as intracranial tumours at the Jerbai Wadia Hospital for Children, 5 turned out to be tuberculomata and the sixth was not a tumour of the glioma group but one of Hans-Schuller-Christian's Syndrome. Of the 5 cases of tuberculoma, 2 were situated in the parietal region, one in the temporal lobe, one in the right cerebellar hemisphere and one in the vermis of the cerebellum. The diagnosis in every one of these cases was established either by operative exploration or by autopsy. He had at that particular moment, two more cases of space occupying brain lesions, which from all the ancillary evidence were indubitably cases of tuberculoma.

He was so struck by the frequency of brain tuberculomata in children, that, when faced with an expanding brain lesion in a child, he made it a point to exclude a tuberculoma, in much the same way that one attempts to exclude a breast cancer in an elderly woman with a lump in the breast.

This is a point of great practical importance, because whereas operation with a view to radical extirpation or palliative decompression is the treatment of choice in intracranial neoplasms, it is extremely doubtful whether the same can be said of tuberculomata.

Though occasional successes have been recorded in the radical ablation of intracranial tuberculomata, the vast majority of explorations for the condition are disastrous from the supervention of tuberculous meningitis in a period of time varying from a few days to a few weeks.

The accurate preoperative diagnosis of intracranial tuberculoma assumes added

importance now, because the known power of streptomycin in controlling tuberculous lesions in the meninges and lungs, makes it probable that the effective conservative therapy of intracranial tuberculomata is at hand, though a lot of experimental and clinical evidence has accumulated in recent times which seems to indicate the contrary.

In arriving at a tentative diagnosis, the following points have been found of value :—

1. Family history of tuberculosis and contact with tuberculous individuals in the household.
2. Positive reaction to Vollmer's patch or to the Mantoux intradermal tuberculin test. A positive response is not conclusive, but a negative test excludes a tuberculous lesion.
3. Evidence of tuberculous infection elsewhere in the body especially in the lung. Routine x-rays of the chest are valuable in diagnosing early pulmonary involvement.
4. Critical examination of the fundus oculi—for as long as half an hour if necessary—in the search of tubercles in the choroid.

The speaker has had two cases demonstrated to him where the signs and symptoms pointed to an intracranial tumour. The correct diagnosis of intracranial tuberculoma was established by the discovery of choroidal tubercles at funduscopy.

Repeated examination of the c.s.f. for the chloride content and the presence of B. tuberculosis on a smear examination (culture of the fluid was not possible) failed to throw any light on the diagnosis. The speaker had seen cases of intracranial tuberculosis where periodic exacerbations of the meningitic symptoms together with

characteristic cytological and chemical changes in the c.s.f. suggested leakage from a localized tuberculous focus into the c.s.f. pathways.

He had hoped by repeated c.s.f. examinations to catch the disease during one of these leaks, and thereby pin the diagnosis down to tuberculoma.

In one of the six cases already referred to, with a tuberculoma in the parietal region, operative exploration was followed by a steady and progressive fall in the c.s.f. chlorides to 600 mgms. and less, indicating that contamination of the fluid pathways had followed operation.

Two other cases in the author's experience, while under observation in the surgical wards, with the diagnostic label of intracranial tumour developed the full-blown picture of tuberculous meningitis.

A cross-section of Bombay is representative of any big industrial city in India, and it was the speaker's object to draw the attention of surgeons in other parts of India to a condition that would be increasingly diagnosed if increasingly suspected.

U. Mohan Rau (*Madras*) presented the following on behalf of the Department of Pathology, Medical College, Madras:—

"Although intracranial tumours are rare, they are not uncommon. Since April 1948, the Pathology Department of Madras Medical College has reported 5 intracranial growths — 2 tuberculomata (one autopsy and the other biopsy), 1 case of medulloblastoma, one pituitary neoplasm and one vascular growth. Their appearance in quick succession has stimulated us to analyse the tumours of brain reported in previous years.

Total number of tumours of brain  
reported excluding 2 cases of  
abscess of the brain .. 38.

The table below gives an analysis of the types of tumours of the brain reported as compared with those of Cushing's series, which consists of 2,023 cases.

Type of Tumours	Number	Percentage	Percentage in Cushing series
Meningioma	...	3 8	13.4
Neurofibroma	...	2 5.2	5.2
Glioma	Medulloblastoma	...	3
	Astroblastoma	...	1
	Spongioblastoma	...	8 21.2 42.6
	Multiforme	...	
	Glioma-unclassified	...	
		2	
Angioma	Haemangio-endothelioma	...	2+1 <sup>†</sup>
	Cavernous Angioma	...	1
			4 10.5 2
Cysticercus Cellulosa	...	6 16	0.8 or nil.
Cyst of choroid & Arachnoid..	...	3 8	nil.
Tuberculoma	...	4 10.5	2
Gumma	...	1 2.6	2
Pituitary Growths	...	2 5.2	17.8
Metastatic Growths	...	5 13.1	4.2
Total	...	38	

\*Not histologically confirmed.

Our figures show a low incidence of glioma and pituitary growths and a high incidence of tuberculomata, metastatic growths, cysticercus cellulosa and angioma. Our data are more in agreement with the statistics of continental and British workers. (Reference: Neurology K. Wilson)."

S. T. Narasimhan (*Madras*). "I would like to stress the usefulness of electro-encephalography in the localisation of brain tumours. With the announcement by Canton in 1874, about the existence of electrical beat in the grey cortex, various workers had made attempts to utilise this phenomena for the benefit of humanity. Berger of Germany was the first to localise tumours in four cases in 1931 with the help of E.E.G. and these were operated upon and confirmed. Grey Walter in 1937 predicted the existence of brain pathology in 12 cases and in all these tumours were removed from the regions indicated. Williams and Gibbs making use of E.E.G., diagnosed brain ab-



normality in 50 cases. Of these, 22 were confirmed at operation or at autopsy; in 10, the diagnoses were established by unequivocal clinical signs or radiological evidence; in 5, bone defects were noted in the skull; and the remaining 13 showed characteristics of epilepsy. In 1943, Bagehi localised 47 cases of brain tumours from the University Hospital, Michigan, and these were confirmed either at the operation or by pneumography or by angiography or at autopsy. In 1946-47, out of the 154 cases of suspected intra-cranial supra-tentorial lesion, he localised 136 cases (88.3%) and these were confirmed either at operation or by pneumography or by angiography or at autopsy. In 1948, he gave nearly 93% correct results, working with over 300 cases. Dr. Bagehi concludes that E.E.G. has passed the stage of pure research and has entered into a phase where it will not only recount its successes but also assess the cause of its failures.

Herewith are two cases of tumours where E.E.G. helped me to localise the lesion :—

Case I. D. D. Admitted 10-8-47. Discharged on 10-12-47.

C.C. Loss of use of right arm and leg for about 4 weeks. Began with gradual loss of strength in right arm. About the same time her husband noticed that she had difficulty in talking and that she would also forget what she had said; was able

to write. Two weeks later she fell and was unconscious for 5 or 10 minutes, with convulsions. Afterwards rt. leg was paralyzed, and she could not talk for 24 hours. Speech gradually returned. Before fall she had severe headache which lasted for a short time. Pt. has had cephalagia, usually frontal, off and on for all her life. No nausea or vomiting except for 24 hours, following fall; no symptoms referable to sight, smell or hearing. She had been more short tempered for last 6 months. She cannot walk alone and tends to drag her rt. leg. No difficulty in walking previous to fall.

*Electro-encephalogram (Figs. 1, 1-a, 1-b and 1-c.)*

You will note from the following record Fig. 1-a, that all the leads were connected to the right ear. The left leads have given rise to slow waves indicative of the existence of a localisable left hemispherical pathology. Then in the Fig. 1-b, triangulation of the left frontal area compared with right, has shown that the pathology is on the left and not on the right. In Fig. 1-c, triangular recording was done of the anterior and posterior regions of the left side of the hemisphere. You will note the slow waves appearing in the anterior region only and not in the posterior region. With many more recordings the tumour was localised at the left fronto-temporal region.

On the strength of this report through an osteoplastic flap a meningeoma weighing 75 gms. was removed. Patient recovered from all the symptoms and walked home on the eighth day.

(Thanks to Dr. B. K. Bagehi, Ph.D. of University Hospital, Ann Arbor, Mich., for the facilities given to me to work on this case and permission given for publication.)

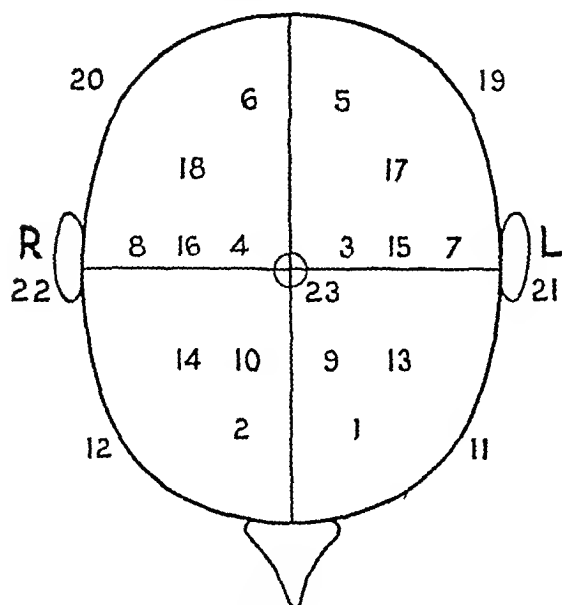


Fig. 1. Lead emplacements in case D. D.

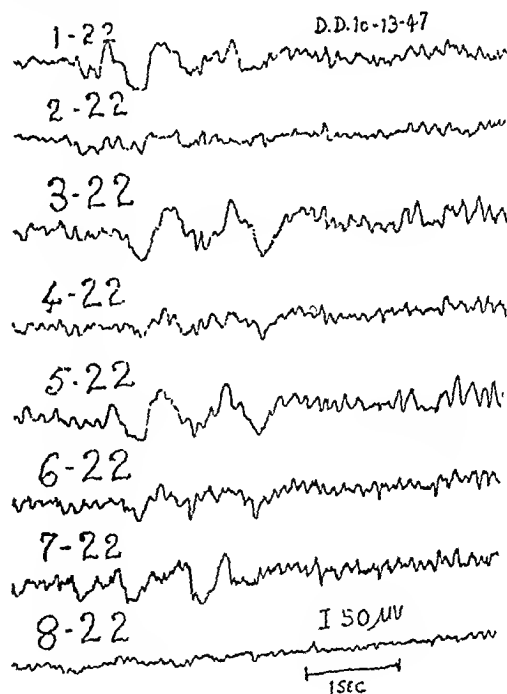


Fig. 1-a.

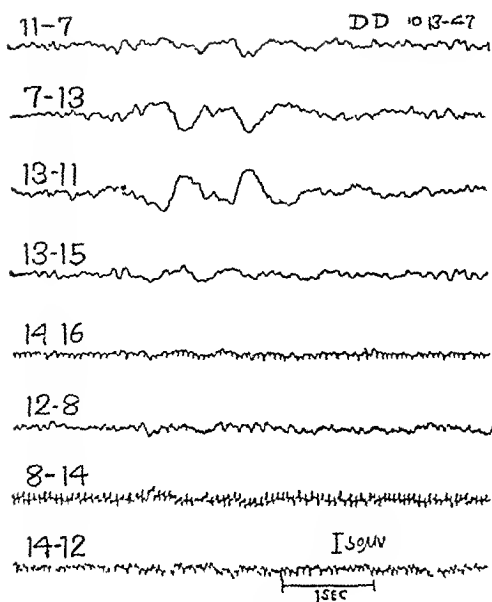


Fig. 1-b.

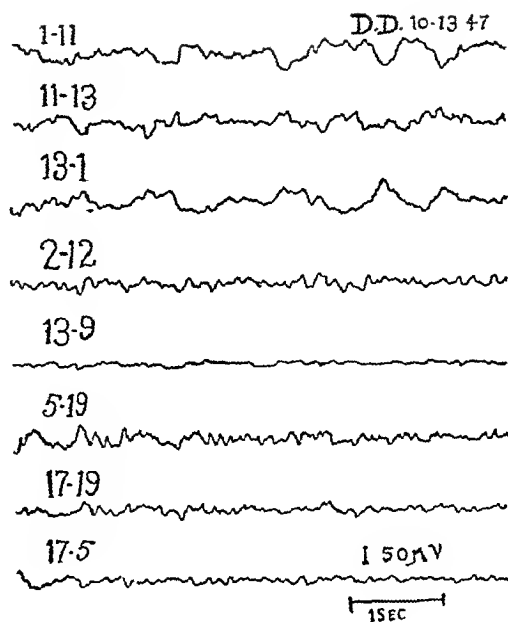


Fig. 1-c.

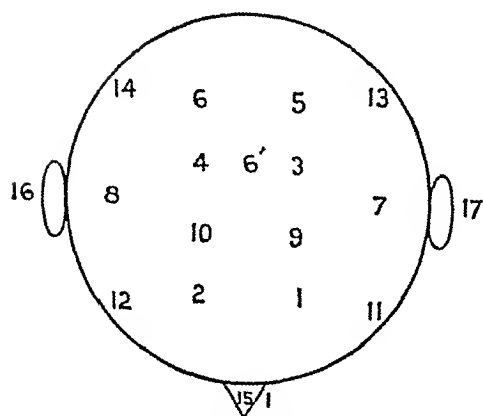


Fig. 2. Lead emplacements in case S. R.

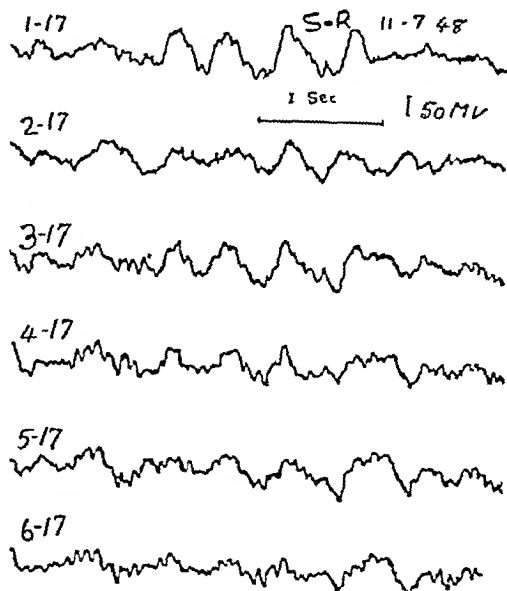


Fig. 2-a.

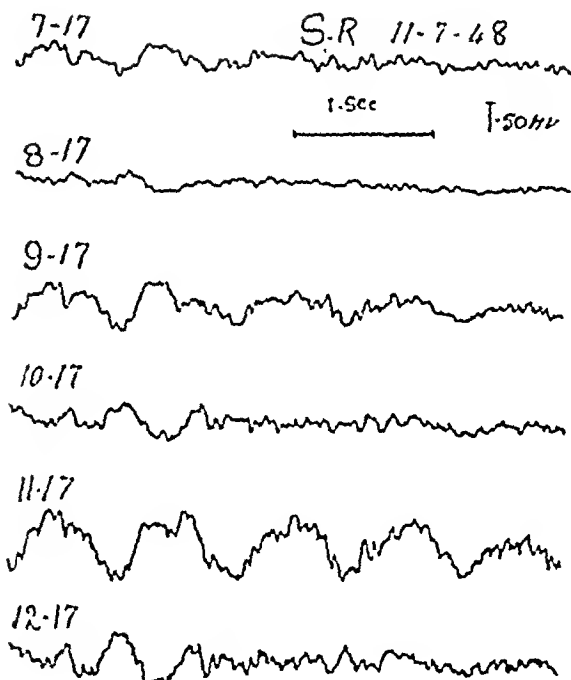


Fig. 2-b.

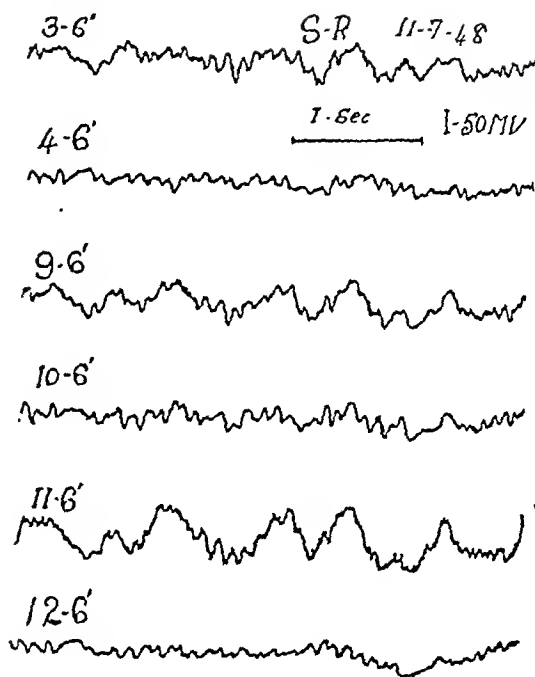


Fig. 2-c.

Case II. Sis. R. Age 42. 11th July 1948.

*Birth History.*—No knowledge.

*Past History.*—Non-contributory.

*Present Complaint.*—Headache and seizures, and difficulty in speaking.

*Previous History.*—In March 1947 she was having her lunch and suddenly she got a blackout. She was not aware of anything but she recovered and found she was in bed. She developed a headache and also nausea and vomiting. She was not able to talk. Subsequently, fits appeared. Others have said that it used to last about 5-7 minutes. She has no knowledge of biting of the tongue or incontinence. Now she is not able to stand up at all. Patient is aphasic. In the hospital, she had a seizure during which she was incontinent. Though she gets headache very often now, she does not get it as heavily as she used to get in the hospital. Her appetite and sleep are normal.

*Electro-encephalogram (Figs. 2, 2-a, 2-b and 2-c.)*

Figs. 2-a and 2-b indicate predominance of the slow waves from all the leads from the left. But leads from areas 9 & 11 are particularly more slow. In Fig. 2-c it is particularly slow at area 11. With the help of other recordings I localised an infiltrating lesion at a point between the tip of the left temporal lobe and the left pre-motor cortex. On the basis of my report and the clinical findings, a left temporal osteoplastic flap was made and a tumour at the Sylvian fissure was found. The pathological report from a biopsy bit being tuberculoma, no attempt was made at removal of this mass.

(Thanks to Dr. C. K. Prasada Rao, M.D., Dr. D. K. Sabesan, M.S., F.R.C.S., and their staff for their co-operation, and the authorities for having allowed me to report this case.)

I feel that more stress should have been laid, in this discussion, on the importance of papilloedema. According to the statistics of University Hospital, Michigan, posterior fossa lesions give 100% papilloedema, frontal lobe lesions 85%, parietal lobe lesions 84%, subcortical lesions 75%, abscesses 25% (and this more commonly in abscesses of the temporal lobe). Another difference is that gliomatous tumours give rise to papilloedema more than the discrete tumours such as meningioma. Acoustic-neurinoma gives rise to papilloedema in 100% of cases.

From my experience, I wish to state that minimal symptoms and signs have been observed when tumours like meningioma weighing about 85 to 120 gms., were found inside the cranium later. Patients have remained asymptomatic till advanced ages as 40—70 years and the first symptoms for admission have been status epilepticus with no past history. Some unilateral pathological reflexes were noted during the

period of coma but after recovery nothing pathological either in the reflexes or in their behaviour was observed. In U.S.A., most of the patients with frontal lobe lesion, who came under my care, had very good war service records. This is an observation from at least six cases seen during my stay there.

Importance should be given to the rapid advancement of symptoms in cases of gliomatous tumours where haemorrhage takes place inside the tumour and more so in cystic astrocytomas.

In most of the 3rd ventricle tumours, the first symptom we get is that of occlusion of the aqueductus of Sylvius.

In cases of olfactory groove meningiomas we get signs and symptoms of hypopituitarism due to the pressure by the backward projection of the tumour and pressure on the pituitary.

Cerebro-spinal fluid variations should have also been discussed. In all posterior fossa tumours including acoustic neuromas, the protein contents are very high. Then come the gliomatous tumours; in meningiomas there may or may not be an increase.

As to the treatment, besides operation, x-rays have been found beneficial in fibrillary astrocytomas, oligodendrogliomas and medulloblastomas. But in glioblastomas no improvement has been noted. In pituitary chromophobe adenomas, x-rays have given beneficial results.

Dr. Cooper stated during his discussion about pneumo-encephalographs, that he could read with the same precision the p.e.g. irrespective of the amount of air filled in. This premise I will not accept, as particularly in p.e.g., the cerebral surfaces will be first filled with air and ventricles will not be filled at all. So it is necessary that a good amount of gas should be used for good interpretation. In the x-ray technique, I have to stress the importance of true positioning without rotation; because even a bit of rotation distorts the picture and hence our interpretation.

V. M. Kaikini (Bombay). Altogether eleven operations were done for lesions of the brain. Out of these eight were for tumours and two were for Jacksonian epilepsy caused by pressure on the brain and one was for meningioma.

Out of the eight brain tumours one was a tuberculoma of the frontal lobe, one was a big gumma of the frontal lobe and one was a sarcoma of the pituitary body in a child aged about three years. Two had tumours in the frontal and two in the parietal lobe. All these were advanced cases. Half of them came with total blindness, one had maniacal symptoms, and all of them complained of ataxia. In two cases coma followed ventriculography from which they did not recover. In the other six cases death occurred on the second or the third day of the operation.

CASE 1. G.S., male admitted for amblyopia, headache, and ataxic gait, of three months duration. Symptoms most marked on the right side. Vision failed first on the right side. No change in the higher functions. Papilloedema on both sides. Gradually the patient became totally blind. The skull was opened by Frazier's method. The left cerebral lobe looked much increased in size. So the left lateral ventricle was tapped. Under the impression that it was a case of pituitary tumour the sella turcica was approached and a small prominence on the lateral side of the pituitary body which looked like a cyst was teased with the finger which caused the exudation of a little fluid rather cily in appearance. Thinking that a cyst had been opened up the wound was closed. But the patient's condition did not improve and he gradually went down-hill and died after about two months in a condition of coma. On post-mortem, the pituitary fossa was found to be normal and a pedunculated papillomatous tumour was found on the cortex of the right parietal lobe. In this case a proper localization of the tumour would have saved the life of the patient after a comparatively simple operation.

CASE 2. Meningioma. Patient aged about 40 admitted in 1931, for a big granulomatous tumour bursting through the skull on the vertex a little to the left side of the middle line. The skull was opened up round about and the whole tumour which was of the size of a small orange was completely removed. During the removal a small tear occurred in the wall of the vertical sinus and in trying to stop the bleeding the tear became bigger and terrible bleeding started. The wound was packed with swabs dipped in eusol solution and

this stopped the bleeding. The packs were removed on the fourth day and the wound was found to be perfectly healthy. The patient was discharged in good condition although he refused to have the skull gap closed by a plastic operation.

Two cases were admitted for symptoms of Jacksonian epileptic fits and severe headache due to fracture of the skull causing a sequestrum to irritate the cerebral cortex. In both cases the skull was opened and the offending piece of bone was removed which gave relief to the patients. In one case in which a large piece of bone had been removed the symptoms recurred after about four years. So the wound was again opened and the fibrous tissue which was the cause of the mischief was removed and to prevent any further complication the gap was covered with a piece of fasci lata. The patient had no further trouble.

**R. Nigam (Nagpur).** (1) Agreed to the excellent work done by Penfield's clinic in Canada and the late Harvey Cushing at Baltimore; (2) criticised the reference by either of the two speakers about the physical sign "cracked pot sound" of Macewen—a sign only of historical value today; (3) remarked on the too great an emphasis laid by Dr. Baliga on Bailey and Cushing's classification of intracranial tumours based on the developmental anatomy and said that there was some disagreement as well today on this attractive theory; (4) disagreed on the routine use of deep x-ray for pituitary tumours without a preliminary decompression, as mere irradiation was a dangerous

procedure sometimes; (5) drew attention to Dandy's posterior subtentorial approach as the one of choice not only for acoustic nerve tumours but also for the surgical treatment for trigeminal neuralgia; (6) mentioned about two recent cases of intracranial calcification due to encephalitis and stressed that tuberculoma was not always the cause of calcification, there being other causes as well. (7) Angiography, he said, could be practicable without a mechanically aided machine. Thorotrast was still used by some as one of choice in spite of its radioactive nature. (8) Lastly he agreed about the value of several plain skiagrams in the diagnosis of intra-cranial tumours.

**V. P. Mehta (Bombay)** stressed the importance of bearing in mind the possibility of cerebral telangiectasis which form a small group of intracranial tumours. He reported two such cases where the diagnosis was more than suspected and suggested that arteriography should be carried out. He also drew attention to the fact that thorotrast should not be used for this purpose as it is radioactive, gets deposited in the tissues and has been reported to produce malignant change in human tissues. The contrast medium of choice is "Diodrast" or "Perabrodil" used as a 35% solution.

# STUDIES ON THE NUTRITIONAL STATE OF SURGICAL PATIENTS

by O. P. MISRA, Agra.\*

## Introduction

During the last few years considerable attention has been directed in the Western clinics towards assessing the nutritional state of patients who are to undergo surgical treatment with a view to reduce the mortality and morbidity and shorten the convalescent period. The introduction during the last few years of plasma and protein hydrolysates has helped attempts to make good nutritional deficiencies, specially the protein fraction, in the short preoperative period available to the surgeon.

Study was, therefore, undertaken to assess the nutritional state of patients admitted to the surgical wards in general and to compare the findings with the average findings in the cross-section of the population of this area. Further, an attempt was made to study the changes in the blood protein fraction of patients as a result of major surgery and to see how far a limited replacement therapy can be of value in helping the patients. Studies, so far attempted in the Western clinics in the matter of replacement therapy have been towards generous and massive transfusions. I have tried to study it from the angle of replacement in very modest amounts.

Since it is the consensus of opinion and my studies too have indicated the same that the blood protein estimations are not a reliable guide of the protein content of the body or of its deficiency I proposed to study the tissue protein changes as suggested by Localio<sup>1</sup>.

## Method

The procedure followed has been to do a physical and a haematological examination. Under the physical examination, apart from routine general examination weight and

blood pressure were recorded to throw light on the general constitution and health of the patient, while haematological investigations were done in the direction of:—

- (i) Total red cell count, haemoglobin percentage, packed cell volume and erythrocyte sedimentation rate.
- (ii) Blood chloride.
- (iii) Nitrogenous constituents of blood—total and fractional protein, urea and n.p.n.

## TECHNIQUE USED FOR THE ESTIMATION OF :—

1. *Blood chloride*—Modified "Water-horn's method".

2. *Urea*—Modified urease Nesslerisation technique.

3. *N.P.N.*—Into 3.2 c.c. nitrogen free distilled water add 0.2 c.c. oxalated blood. Mix, add 0.3 c.c. 10% sodium tungstate and 0.3 c.c. 2/3 sulphuric acid. Mix thoroughly wait for five minutes and centrifuge down the precipitate. Into 1 c.c. of the supernatant fluid taken in a boiling tube add 0.2 c.c. 50% nitrogen free sulphuric acid containing 1% selenium dioxide. Evaporate on a flame till the fluid becomes dark; then heat gently till acid fumes come out and the darkened fluid again becomes clear. Heat for 2-3 minutes more and then let it cool. Add 5 c.c. distilled water, mix thoroughly and add 3 c.c. Nessler's solution. Match the colour developed against a standard prepared by taking 2 c.c. of ammonium chloride solution (1 c.c. — 0.01 mg. nitrogen) in 3 c.c. distilled water and adding 3 c.c. Nessler's solution to it.

$$N.P.N. = \frac{\text{Reading of the standard}}{\text{Reading of the test}} \times 40 \text{ mg/100 cc}$$

4. *Total Protein*—0.2 c.c. plasma is diluted to 20 c.c. with normal saline, 0.5 c.c. of this is taken in a centrifuge tube containing

\*From the Dept. of Surgery, Medical College, Agra.

4 c.c. distilled water. Add 0.1 c.c. zinc sulphate solution and 0.1 c.c. 0.5 N. sodium hydroxide solution, mix, wait for 5 minutes and then centrifuge down the precipitate. Remove away the supernatant fluid and drain the inverted tube on a filter paper for a few minutes. Digest the precipitate with 0.2 c.c. of 50% sulphuric acid containing 1% selenium dioxide and nesslerise as above. Compare the colour developed with a standard prepared by adding 3 c.c. of Nessler's solution to 5 c.c. of the above mentioned ammonium chloride solution.

$$\text{Total Protein} = \frac{\text{Reading of the standard}}{\text{Reading of the test}} \times \frac{6.25 \text{ g/100 cc}}{100 \text{ cc}}$$

5. *Fibrinogen*—To 10 c.c. of the above diluted plasma taken in a narrow tube add 0.2 c.c. calcium chloride solution. The tube is kept at room temperature untouched till fibrin clot is formed (from 30 minutes to 24 hours). Gently remove the clot with a glass rod, wash it with distilled water, dry it on a filter paper and put in a tube containing 0.2 c.c. 50% sulphuric acid containing 1% selenium dioxide. Digest, nesslerise and match as in the case of total protein.

$$\text{Fibrinogen} = \frac{\text{Reading of the standard}}{\text{Reading of the test}} \times \frac{0.3125 \text{ g/100 cc}}{100 \text{ cc}}$$

6. *Albumin*—Take 0.2 c.c. plasma in a 10 c.c. volumetric flask containing a micro-

drop of capryl alcohol and make up the volume with sodium sulphite solution. Mix thoroughly, keep for 10 minutes and filter. Take 0.5 c.c. filtrate in a centrifuge tube containing 4 c.c. distilled water. Precipitation, digestion, nesslerisation and matching is done exactly as described for total protein.

$$\text{Albumin} = \frac{\text{Reading of the standard}}{\text{Reading of the test}} \times \frac{3.125 \text{ g/100 cc}}{100 \text{ cc}}$$

7. *Globulin*—Total protein — (Albumin + fibrinogen) g/100 c.c.

### Observation and Conclusions

I. The nutritional state of surgical cases in general tends to be at a lower level as compared with the normal representative standard in this area. On an average they are found to be markedly reduced in weight, anaemic and hypoalbuminic. Yet the total plasma protein was found to be at a slightly higher level probably because of markedly raised plasma globulin concentration.

75 patients were examined who were admitted to the surgical wards in general and the average findings compared with the average findings of 50 normal persons representing the cross section of the population of this area. The findings are recorded in table no. 1.

TABLE No. 1

No.	Items	Normal Cases	Surgical Cases
1.	Age	28 years	37 years
2.	Weight	116 lbs	95 lbs
3.	B P	110/67	110/67
4.	Total R B C	5,220,000/cmm	4,100,000/cmm
5.	Haemoglobin	14 g/100 cc	11 g/100 cc
6.	Sedimentation rate	15 mm after 1st hour	22 mm
7.	Packed cell volume	39 cc/100 cc	31 cc/100 cc
8.	Blood urea	30 mg/100 cc	33 mg/100 cc
9.	Blood N.P.N.	27 mg/100 cc	30 mg/100 cc
10.	Blood chloride	471 mg/100 cc	457 mg/100 cc
11.	Total protein	5.67 g/100 cc	5.78 g/100 cc
12.	Albumin	3.4 g/100 cc	3.11 g/100 cc
13.	Globulin	1.99 g/100 cc	2.39 g/100 cc
14.	Fibrinogen	0.28 g/100 cc	0.28 g/100 cc
15.	Sp. Gr. of urine	1013	1018

We find that in surgical cases albumin concentration is 0.29 g% less as compared to the normal cases while the rise in globulin is 0.4 g%. The level of fibrinogen remains equal in both groups, and hence the total plasma protein is raised by 0.11 g%. Seeing the amount of weight lost by the surgical patients on an average i.e. about 20 lbs., and comparing it with the loss of plasma albumin, I feel, I should admit what Ravdin<sup>2</sup> predicted — "..... if the means to determine it were available, the first of protein under-nutrition is a reduction in the amount of protein stored in the tissues of the body, since every attempt is made to maintain the serum protein concentration at a nearly normal level". The total red cell count in surgical cases, though at a comparatively lower level, is still within normal limits, the anaemia in them being essentially due to subnormal haemoglobin concentration. This lowered haemoglobin percentage cannot be explained by postulating a deficiency of iron because the sources of iron supply in both groups are the same. Hence I am inclined to associate this "anaemia of infection" as it is called, with an altered protein metabolism of the body as a result of surgical disease, protein being essential for haemoglobin formation. The blood urea, non-protein nitrogen and blood chlorides show little change.

II. Study of cases which died after admission in the surgical ward or progressively deteriorated showed that in these cases there was comparatively a persistent-

ly lowered plasma albumin concentration. Further repeated examinations showed a rise in non-protein nitrogen and blood urea and a fall in albumin percentage, if the patient was going down hill. With plasma albumin concentrations persistently below 3 g%, a marked sustained rise of blood urea and non-protein nitrogen concentrations is definitely of bad omen.

Eight cases in an extremely serious condition were subjected to nutritional studies. In these cases operative interference was either not done or was done to a minimum extent.

Four out of these were in the stage of advanced cohexia. Their important findings have been summarised in Table No. 2 (a).

It is evident at the first glance that the total plasma protein ranging roughly between 4 and 8 g% gives no indication of the general health of the patient, though the average level of the first examination is 5.08 g%. However, albumin concentration is throughout below 3.8 g%, the average level at the first examination being only 2.23 g%. Blood urea and non-protein nitrogen concentrations in all the four cases were within normal limits at the first examination, and these, at the second examination repeated within 3 to 12 days, were found to be markedly raised. Three cases died before a third test could be repeated, while the fourth who expired a few days after one more test, showed a further

TABLE No. 2. (a)

Investigation	Case No. 1 Liver Abscess		Case No. 2 Empyema		Case No. 3 Cystitis		Case No. 4 Enlarged Prostate			
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	3rd	
	Exam.	Exam.	Exam.	Exam.	Exam.	Exam.	Exam.	Exam.	Exam.	
Blood urea mg%	...	38.9	53.5	26.6	61.1	42.8	85.6	42.8	67.1	155.6
Blood N. P. N. "	..	35.5	48	24	54.8	38.7	77	38.5	60.3	140
Total protein g %		5.2	4.17	4.81	4.73	4.46	4.63	5.55	6.94	7.81
Albumin g %	...	2.80	2.23	2.34	2.6	1.2	1.33	2.4	2.5	2.98
Globulin g %	...	1.17	1.83	2.13	2.07	3.16	3.19	3.06	4.27	4.55
Fibrinogen "	...	0.52	0.11	0.34	0.06	0.1	0.11	0.1	0.17	0.78



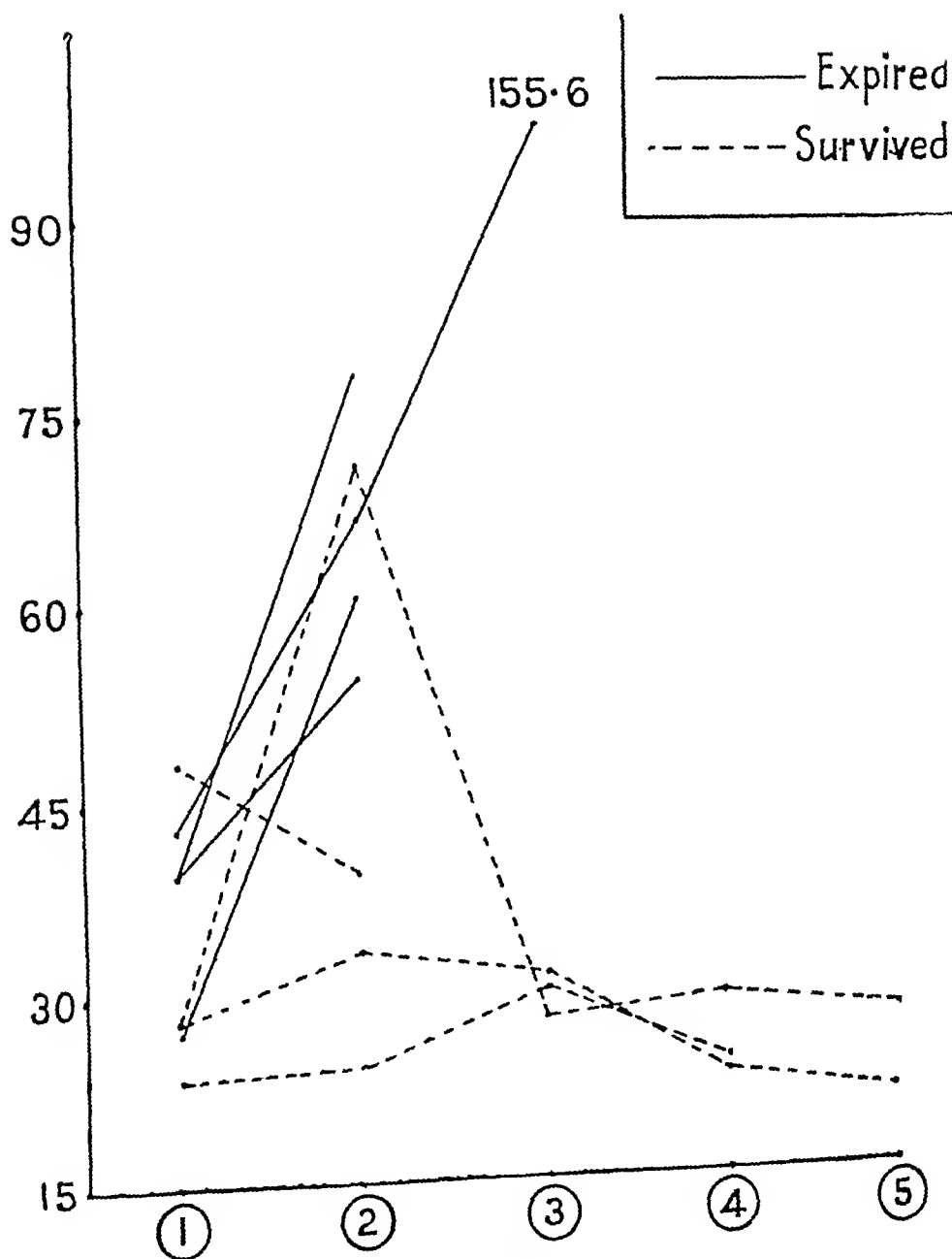


Chart 1.

increase in urea and non-protein nitrogen concentration on the blood (Chart No. 1).

The other four cases, though in a serious condition were not so poor in general health and the findings are recorded in Table No. 2 (b).

We find that though the lower level of the range of the total protein is definitely higher, the average concentration at the 1st examination being 5.84 g% is not very

different from the previous group. On the other hand albumin concentration in this group is decidedly more, the average at the 1st examination being 3.29 g%. Here blood urea and non-protein nitrogen concentration either did not go up or the rise was slight and temporary (Chart No. 1) except in one case (Case No. 5). This case showed a rapid and a marked rise in these, yet this rise was for a short duration and accompanied with uraemic symptoms as op-

TABLE No 2 (b)

Case No.	Exam. No.	Urea mg%	N. P. N. mg%	T. Protein g%	Albumin g%	Globulin g%	Fibrinogen g%
5 Fracture spine with paraplegia	1	28.5	25.5	6.25	3.91	2.03	0.31
	2	71.3	64.5	6.25	3.91	2.03	0.31
	3	28.5	25.5	4.8	2.4	2.08	0.32
	4	29.5	26.5	5.	2.08	2.66	0.26
	5	28.5	25.5	4.38	1.12	3.12	0.14
6 Extensive 3rd degree burns	1	28.5	25.6	5.72	3.31	1.38	0.31
	2	32.9	29.6	4.65	2.55	1.43	0.67
	3	30.5	27.5	4.88	2.0	2.1	0.78
	4	23.1	20.7	6.25	3.22	2.58	0.45
	5	21.3	19.1	6.25	3.47	2.5	0.28
7 Stab wound chest	1	47.5	49.5	5.38	2.79	2.49	0.1
	2	38.6	34.7	5.73	2.29	2.13	0.37
8 Multiple fractures	1	23.1	20.9	6	3.13	2.52	0.35
	2	23.7	21.3	5.5	2.23	2.95	0.32
	3	30.4	27.3	5.76	2.74	2.9	0.13
	4	24.1	21.6	7.35	3.29	3.82	0.24

TABLE No 3 (a)

No	Nature of the Operation	PRE OPERATIVE				POST-OPERATIVE				
		T. Prn	Alb	Glb	Fib	T. Prn	Alb	Glb	Fib	
1.	Cholecystectomy	...	5.21	3.13	1.77	0.31	5.22	2.64	2.06	0.52
2.	Cholecystectomy		5.12	2.6	1.84	0.68	6.47	2.98	2.86	0.63
3.	Stellate ganglionectomy	...	6.95	3.13	3.58	0.24	7.18	2.6	4.34	0.24
4.	Hernioplasty	...	5.21	4.17	0.92	0.12	6.0	3.13	2.72	0.15
5.	Nephrectomy	...	6.64	2.92	3.3	0.42	6.76	2.84	3.61	0.31
6.	Prostatectomy	...	5.56	2.4	3.06	0.1	6.94	2.5	4.27	0.17
7.	Parathyroidectomy	...	5.95	3.47	2.35	0.13	5.61	3.47	1.79	0.35
8.	Laparotomy		6.94	3.13	3.68	0.13	5.43	2.08	3.05	0.3
9.	Uretero-lithotomy		6.94	3.47	3.11	0.36	6.58	4.46	1.77	0.35
10.	Ileo-transverse colostomy		5.68	3.91	1.52	0.25	4.63	2.4	1.92	0.31
11.	Ureteric transplantation		6.25	3.68	2.09	0.48	5.2	3.38	1.04	0.78
12.	Laparotomy		6.25	2.72	3.31	0.22	6.25	2.29	2.74	0.22

posed to the rise in the previous group of cases, where it was sustained and was unaccompanied by any uraemic symptom. Examinations repeated in this case up to a period of the next one and a half months did not show any rise of urea and non-protein nitrogen concentration. However, total plasma protein and albumin came down gradually to a very low level, reducing a

flabby patient to a mere skeleton when he left against medical advice. The three others improved gradually and soon achieved a satisfactory general condition.

III. The effect of major surgery on the nutritional state was studied on a group of 12 cases. Preoperative and post-operative findings are recorded in Table No. 3 (a) and (b).

TABLE No. 3 (b) (Values are in g%)

Item	Nature of change	Number of Cases	RANGE		Average
			From	To	
Total Protein g%	Rise	6	0.01	1.38	0.65
	Fall	5	0.34	1.51	0.86
	No change	1			
Albumin g%	Rise	4	0.1	0.99	0.51
	Fall	7	0.08	1.51	0.71
	No change	1			
Globulin g%	Rise	7	0.20	1.8	0.83
	Fall	5	0.56	1.34	0.83
	No change	—			
Fibrinogen g%	Rise	7	0.03	0.3	0.15
	Fall	3	0.01	0.11	0.06
	No change	2			

There was an average increase of 0.65 g% in the level of total plasma protein in 6 out of 12 cases with an average fall of 0.86 g% in five of the other 6, one case showing no change. This increase in the level of total plasma protein corresponds with an increase in globulin of 0.83 g% on an average in 7 cases. Again, on the other hand albumin concentration showed an average fall of 0.71 g% in 7 cases while only 4 cases had an average rise of 0.51 g%.

Thus studies on plasma protein in this group indicate a tendency for albumin to fall in the majority of cases, reflecting on the level of the total protein, yet the latter is found to be increased in most of the cases, which is due to a simultaneous increase in the globulin and fibrinogen portions.

I feel that the change in the protein fractions in the post-operative period is governed by several factors, namely:—

- i. The level at which they have been stabilised in that individual.
- ii. The demand that has been made on the reserve as a result of operation.
- iii. The haemodilution or the haemo-concentration.
- iv. The effect of replacement therapy.

The given finding in any particular case is, therefore, the end result of these four forces. This explains to a great deal the disparity in the findings of the different workers in this field, and has been partly responsible for the erroneous conclusions drawn from a temporary benefit of replacement therapy. I feel that this type of study should be repeated by estimations of tissue proteins by the technique described by Localio. It has been my feeling that in most of the surgical patients we meet with, the metabolism is geared to a lower level. Due to a prolonged low nutritional state, the body has adapted itself to meeting the emergencies of life and extra calls, by a more rapid mobilisation of its economy. We thus see that though their nutritional state is low they are able to steer through the post-operative course of major surgery comparatively well and with the help of a comparatively small replacement therapy.

Coming back to the original point, I am inclined to think that in the majority of cases, the brunt of the operation has to be borne by the albumin fraction, that the increase in globulin is in no way connected with surgery (so much so that if the factors responsible for its increase are absent this also follows suit with the albumin), that the increase in fibrinogen is a rational answer to the call for repair of the opera-

TABLE 4 (a) Immediate effect of operation on plasma globulin

No.	Diagnosis	Preoperative Globulin g%	Postoperative Globulin g%	Rise	Fall g%
Associated with infection	I. Cholelithiasis	...	1.77	2.06	0.29
	II. Cholelithiasis	...	1.84	2.86	1.02
	III. Renal calcinosis	...	3.3	3.61	0.31
	IV. Enlarged prostate	...	3.06	4.27	1.21
	V. Ileocaecal tuberculosis	...	1.52	1.92	0.4
	VI. Appendicular abscess	...	3.72	3.71	0.01
Unassociated with infection	VII. Vesico-vaginal fistula	...	2.09	1.04	1.05
	VIII. Parathyroid tumour	...	2.35	1.79	0.56
	IX. Cancer gall bladder	...	3.68	3.05	0.63
	X. Ureteric stone	...	3.11	1.77	1.34
	XI. Buerger's disease	...	3.58	4.34	0.76
	XII. Incisional hernia	...	0.92	2.72	1.8

TABLE 4 (b)

Case No. & Diagnosis	Duration	Globulin g%
XIII. Spinal fracture with cystitis	...	Initial
	4th day	2.03
	24th day	2.03
	56th day	2.66
	79th day	3.12
XIV. Extensive 3rd degree burns	...	Initial
	4th day	1.38
	6th day	1.43
	24th day	2.1
	69th day	2.58
XV. Multiple fractures with minor injuries	...	Initial
	2nd day	2.52
	8th day	2.95
	27th day	2.89
XVI. Compound fracture tibia & fibula	...	Initial
	12th day	2.95
	32nd day	2.25

tion wounds and finally that the increase or decrease of total protein has no significance in itself.

IV. Studies on the behaviour of the plasma globulin concentration indicate that the body tries to win over infection by raising plasma globulin concentration and if it fails to increase, the infection usually persists.

The result of pre- and post-operative plasma globulin estimations done on a group of 12 cases are shown in table 4 (a) and chart 2 (a):—

We find that in the majority of cases unassociated with infection the globulin concentration was lowered while it was raised in most of the cases associated with infection,

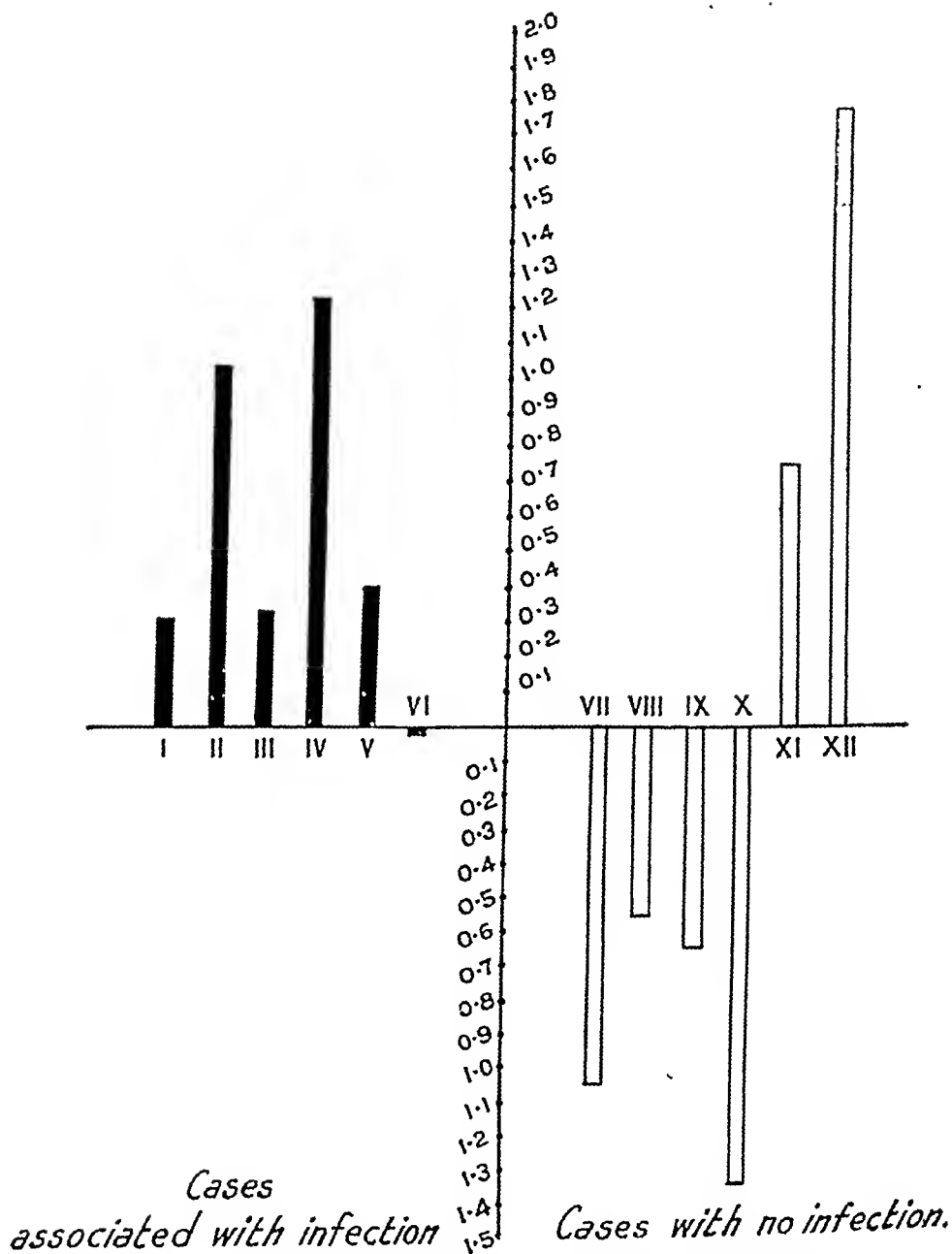


Chart 2-a. Immediate effect of operation on plasma globulin.

In table 4 (b) and chart 2 (b) observations on another group of four patients are recorded.

The first two (case No. XIII and case No. XIV) came with normal plasma globulin, but both of them in spite of penicillin and chemotherapy in heavy doses developed symptoms of acute infection. While the in-

fection in the first case could not be controlled till the very end, plasma globulin showed a slow gradual rise; in the second case, however the swinging temperature was brought down to normal comparatively rapidly with a corresponding rapid rise of globulin in plasma, which later was shown to drop down a little after the temperature had been normal for a few days.

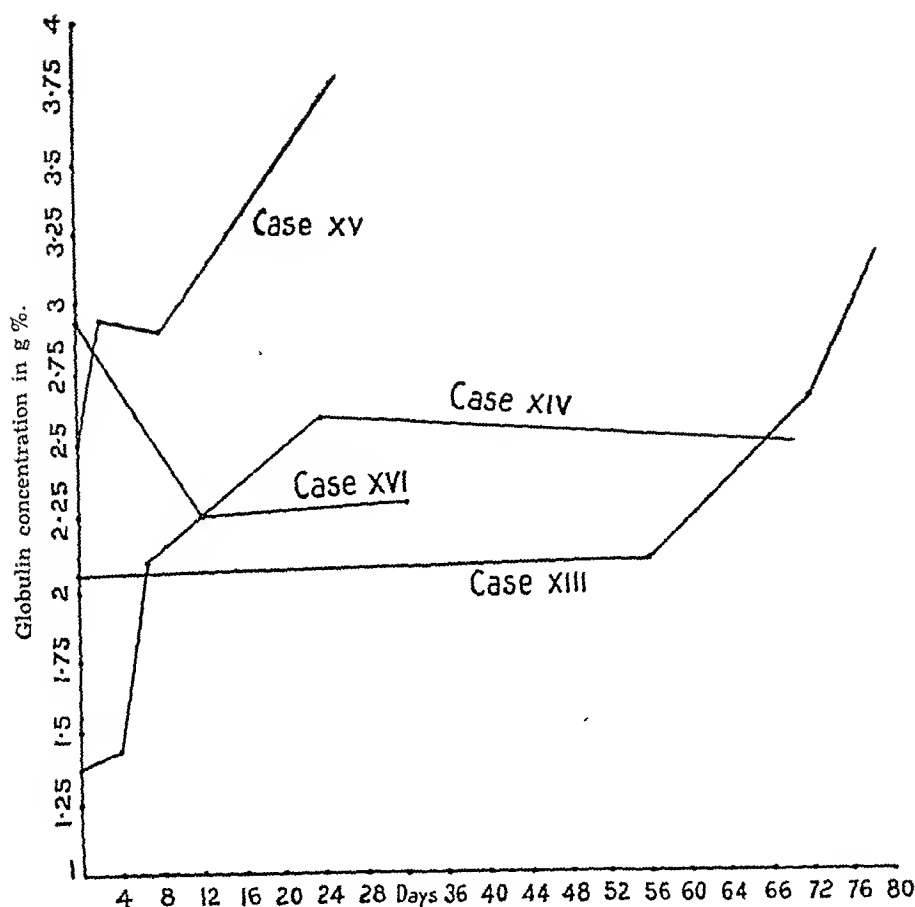


Chart 2-b.

The other two cases of this group were admitted with an initially raised plasma globulin concentration; one of these (case No. XVI) was running no temperature and examination repeated after a few days revealed a fall in globulin. In the other (case No. XV) streptomycin, penicillin and chemotherapy, could not bring down the temperature which remained swinging at a high level though the globulin concentration showed a rapid rise. It was more arresting because the general condition of the patient had improved considerably by now. Unfortunately, however, the study had to be given up at this stage.

This work was carried out under the guidance and supervision of Professor S. C. Misra, F.R.C.S., Head of the Department of Surgery, during my tenure as a Research Scholar in the department of Surgery. My thanks are specially due to Dr. H. N. Bhat, Principal, Medical College and to Dr. M. G. Chakravarti, Head of the Biochemistry Department for the facilities offered for the completion of this work.

### Summary

Four different studies on the nutritional state of surgical patients have been given with special reference to plasma protein, whereby an attempt has been made to show:—

- i. That the average nutritional state of the patients admitted to the surgical wards in general is at a lower level than the average representative standard in this area of the population.
- ii. That there is a post-operative fall in plasma albumin concentration in the majority of the cases as well as that the total plasma protein estimation has no significance in itself.
- iii. That the cases who either die or go progressively down hill, show a marked and progressive fall in plasma albumin concentration, as well as, a marked sustained rise in blood urea and non-protein nitrogen.
- iv. That the behaviour of plasma globulin concentration depends upon and is associated with infection in the body.

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# PRIMARY CARCINOMA OF THE LIVER\*

by M. THANGAVELU, Madras.

The greater incidence of primary carcinoma of the liver in the native races of India (Basu), East Indies (Vogel) and South Africa (Berman) has been reiterated by many and this increased incidence was mentioned to be proportional to the frequency of the cirrhosis of the liver. The cirrhosis is being attributed to the malnutrition or faulty dietary associated with the low economic status of these races (and to no other cause?). The excessive ingestion of carbohydrates with low protein and fat may be the main cause. The author wishes to make a suggestion that the unstimulating carbohydrate which is not a good cholagogue could be considered as a causative factor in the development of cirrhosis and subsequent development of carcinoma. This needs experimental confirmation. The role of methyl cholanthrene as a carcinogen with particular reference to carcinoma consequent upon cholestasis in cirrhosis should offer a promising field for investigation.

It is proposed to present in this paper some data collected from the autopsy records of the Department of Pathology, Medical College, Madras, regarding the incidence of primary neoplasms of the liver.

A study of 1,613 unselected consecutive autopsies conducted during a period of 18 years showed 81 cases of cirrhosis and 15 of primary carcinoma of the liver. The age and sex incidence of the primary neoplasms are given in the following table :

Total number of autopsies (1931-48)	..	1,613
No of autopsies on cirrhosis of liver	..	81 or 5.0%
No of autopsies on all cases of malignancy	..	114
No. of autopsies on primary neoplasms of liver	..	15 or 0.9%

\*From the Dept. of Pathology, Madras Medical College.

Age incidence :	21 — 30	..	1 case
	31 — 40	..	13 cases
	51 — 60	..	1 case
			15

All the recorded cases were in males. This sex immunity is incidental and not absolute for females, for during the last six months two cases of primary neoplasms of the liver in the females were diagnosed by liver biopsy in the Government General Hospital, Madras. It would therefore be more appropriate to state that there is a relative infrequency in the females. It is an observed fact that the incidence of cirrhosis in the females is lower than in males and accepting the aetiology of cirrhosis and carcinoma as described above, this lower frequency of carcinoma in females could possibly be explained.

Whether oestrin or any other hormone offers a relative protection to the female, is an interesting question that may be taken up for an answer.

A few important autopsy observations :



Fig. 1.

Microscopic metastasis in the lung. The tumour emboli from a giant hepatoma is undergoing disintegration in the lumen of a blood vessel and is seen infiltrating the vessel wall.





Fig. 2.  
Giant hepatoma of the liver.

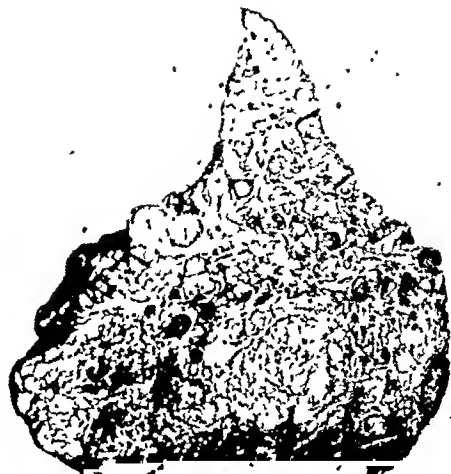


Fig. 4.  
Nodular hepatoma (multicentric) with cirrhosis.



Fig. 3.  
Giant hepatoma involving the right lobe of the liver with extensive necrosis and haemorrhage. The left lobe is small and cirrhotic.



Fig. 5.  
Nodular hepatoma of the confluent type with cirrhosis.

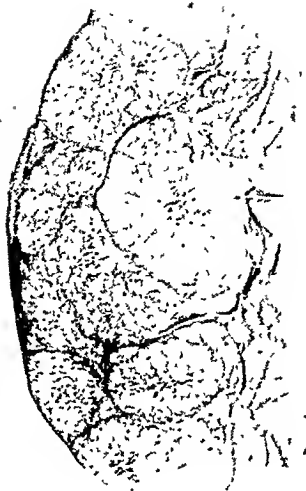


Fig. 6.  
Hepatoma—lotus leaf pattern.

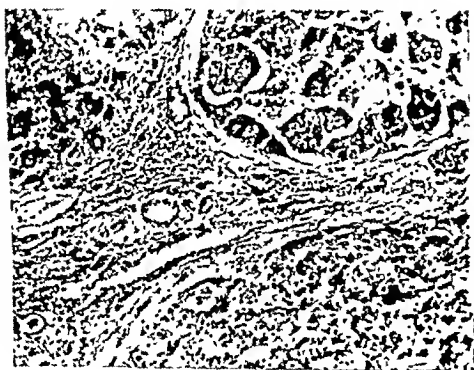


Fig. 7.  
Hepatoma with cirrhosis—the typical giant cells in the hyperplastic nodules with malignant transformation.

In this series ascites with an exudate often bile-stained and blood-stained was a frequent feature. Secondaries were noticed in the lungs in 3 cases, and in one of these, only a microscopic evidence of metastases was present (Fig. 1).

Primary growths in other parts of the body had been ruled out and in partial autopsies a search for obvious frank primary growths in the alimentary tract was carried out, as far as practicable.

The highest weight of the tumour bearing liver was 4,620 grammes.

The morphological variants were either giant hepatomas (Figs. 2 & 3) or nodular growths (multicentric ?) (Figs. 4 & 5).

It was usually the right lobe which was involved in the giant hepatomas and very often extensive necrosis and haemorrhages were noticed in the centre of the growth. The necrosis and the haemorrhage may account for the fever and for the acute onset of symptoms and the sudden death which occurred in some of these cases.

Where the tumour was composed of many nodules (multicentric origin of the neoplasm ?) cirrhosis was very marked. In giant hepatoma cirrhosis was present, but such extreme degrees of fibrosis and nodular hyperplasia of the parenchyma were not evident. An intermediate type of morphological variant "Lotus leaf" pattern of the nodules was also noticed in some tumorous livers (Fig. 6).

Histologically the picture varied in the different tumours. The classical picture of malignant hepatoma with giant cells was seen only in those cases associated with cirrhosis (of possibly multicentric origin) (Fig. 7). In a giant hepatoma the necrosis often destroyed the original histological pattern. In the surviving tumour areas extensive sheets of cells were to be seen; in places a trabecular or papillary pattern was noticed (Fig. 8).

An adenocarcinomatous pattern of bile-duct-origin often suggested a secondary infiltration of the liver but the anarchic proliferative tendency of the bile duct epithelium in the portal tracts aided the diagnosis of a primary neoplasm from biliary epithelium.

The epithelium of the bile ducts and also the parenchymal cells arise from the endo-



Fig. 8.

Giant hepatoma—histologically presenting a trabecular or a papillary pattern.



Fig. 9.

Hepatoma—undifferentiated cells in an anaplastic growth.

derm. These differ in structure and function depending upon the degree of differentiation. In neoplastic processes, the confusing histological picture could be understood if this endodermal origin is taken into consideration. In those growths of an anaplastic nature sheets of undifferentiated cells with extensive necrosis were noticed (Fig. 9).

Hepatoma and cholangioma are better differentiated tumours and hepatoma is associated with cirrhosis—this suggests the

origin of the tumour as a result of unbridled proliferation of the parenchymal cells in cirrhosis of the liver. The bio-chemical factor or factors which activate and control the proliferation and differentiation of these cells (epithelial or epithelial and connective tissue) await experimental confirmation.

I am indebted to Prof. P. V. Gharpure for the helpful advice and criticism in the preparation of the paper and to Prof. K. C. Jacob for permission to make use of the material in the Department of Pathology for study.

# CHORION-EPITHELIOMA UTERI

(with a case-report)

by N. C. SEN, Disergarh.

## Introduction

Chorion-epithelioma is a rare malignant neoplasm which arises from the chorionic epithelium and secondarily invades the adjoining uterus. This growth may follow a full time pregnancy, an abortion or commonly a hydatidiform mole, either immediately or remotely. It may also follow an ectopic pregnancy, for example, in the fallopian tube and ovary. In the latter, it may arise also as a teratoma as in the testis.

Its highest incidence is from hydatidiform mole. According to Novak,<sup>9</sup> 50% of these growths arise from a previous hydatidiform mole, and the rest follow, almost equally, an abortion or a full time pregnancy. The case mentioned below is after an abortion.

## Case Notes

Mrs. R. D. aged 39, complained of bleeding per vaginum for one and a half months following an abortion after three months' pregnancy. The bleeding although continuous, increased from time to time, when large clots came and the patient felt very weak. She also complained of fever from time to time lasting for about 4 to 5 days at a stretch. She had a firm swelling in the hypogastric region for about a year and a half which had become very painful for the last one month.

**Menstrual History.**—She had regular periods but prolonged for the last two years, lasting for about 8 to 10 days at a time.

**Obstetric History.**—Five children, youngest 8 years old.

**General Condition.**—Anaemic, (haemoglobin—48% Sahli); heart, lungs, liver, spleen—normal. Blood pressure—98/56 mm. Pulse, temperature and respiration—normal.

**Local examination.**—Abdominal examination revealed a tender firm lump, irregular in shape, arising from the pelvis, up to about 3 inches above the symphysis pubis. Vaginally the tumour was found to be uterine. There was no abnormality felt through the fornices. The cervix was hypertrophied and torn on both sides laterally. There was an erosion on the posterior lip. The bleeding was coming through the external os. Vulva and the vagina were slightly pale but no other abnormality was visible.

The bleeding was thought to be due to some retained products of conception and dilatation and curettage was done. A deep purple friable soft mass was brought out which on microscopic section revealed a picture of choriocarcinoma. Pathologist's report was as follows — "Tissue composed of large irregular polyhedral cells (Langhans Cells) with hyperchromatic nuclei and many mitotic figures forming large cellular areas showing no stroma. Scattered sparsely at the periphery of these cell masses were masses of syncytium with multiple deeply stained nuclei. No trace of chorionic villi was visible. There were large masses of necrotic tissue with round cell infiltration at their periphery. The picture appears to be that of Ewing's Choriocarcinoma." (Vide microphotograph.)

The patient had blood transfusion (10 ounces) and was made ready for operation. Total hysterectomy with bilateral salpingo-oophorectomy was performed. The tubes and ovaries were healthy but the uterus had a number of fibromyomas (4 in all), two of them fairly big. Specimen on examination showed that the largest of the fibromyoma (about 2½" in diameter) had undergone extensive degeneration. The uterine cavity was larger than average. It presented a deep purple coloured, soft, friable, sessile growth situated a little above the internal os on the right side.

The patient had transfusion of serum during and after the operation and made an uneventful recovery. She was followed up for 8 months but showed no recurrence. Skiagram of the chest before and after the operation showed no abnormality.

## Discussion

**History.**—When first described its true nature was unknown. Sanger<sup>3</sup> in 1888, believed it to arise from decidual cells and employed the term "Deciduoma Malignum". In 1898, Merchand<sup>3</sup> discovered the true origin of the tumour from the chorionic villi and identified its cells with that of the syncytial and Langhans's layers of trophoblast. Following his time about 1,800 cases have so far been reported.

This condition is often erroneously diagnosed because of the peculiar property of invasion and metastasis of the normal trophoblast. Even in normal pregnancy the uterine musculature is frequently invaded to a considerable depth, specially at the



Fig. 1.

Microphotograph of a section of the tumour, showing a large mass of Langhans cells with hyperchromatic nuclei and many mitotic figures towards left side. On the right, there is a mass of necrotic tissue with round cell infiltration at its periphery. Syncytial element of the tumour is not shown. There is no trace of villi to be seen.

placental site by chorionic wandering cells. Moreover, masses of trophoblasts, and even clumps of chorionic villi, may be detected in the veins of the uterine wall or for that matter, may be deported to distant fields, more particularly the lungs. Schmorl's<sup>11</sup> well known studies on this point, indicate that such trophoblastic emboli occur in at least 80% of women during normal pregnancy. Thus this epithelium although benign in nature simulates malignancy. Again, because of the great growth-activity in all chorionic tissue, benign or malignant, differentiation of the latter by means of cellular characteristics is often very difficult. A great many cases of benign hydatidiform mole, itself invasive along venous channels, were thus in the past misdiagnosed as chorionepithelioma. This may be a reason for different figures of its frequency of incidence after hydatidiform mole. This varied from 1% (Novak) to 31.5% (Findlay). One feature that marks this tumour is the

extreme proliferation of the epithelium, far beyond the corresponding supporting stroma, so that the villous structure is lost. Masses of trophoblast cells without the supporting stroma is the hallmark of malignancy.

*Age Incidence.*—Unlike other malignant diseases of the uterus, this tumour is most frequent at the period of greatest sexual activity. Average is 33 years (Teacher)<sup>12</sup> and the maximum incidence of the disease in Brew's series lies between 30 to 39. Sunde believes that its incidence is higher after 40 years when, according to Essen-Moller,<sup>6</sup> vesicular mole is more liable to end in malignancy.

*Parity.*—It has not much importance, although a high degree of fertility may have a predisposing effect. Multiparae are more affected for the apparent reason of there being more multiparae than primiparae. Mathieu<sup>7</sup> gives a proportion of 19 : 9.

*Time of Appearance.*—The interval between the termination of a pregnancy and the development of chorion epithelioma varies widely. An interval as long as 31 years has been recorded. As this is difficult to believe, it is reasonable to suppose the occurrence of an unrecognised pregnancy immediately preceding the appearance of the tumour and it is doubtful if this point can be settled without a proper menstrual history from the patient. Munro Kerr,<sup>6</sup> however, warns against ignoring fairly long latent periods, saying that the clinical evidence of tumour may be delayed upto 9 to 12 months. Alan Brews<sup>2</sup> notes that undoubted cases of chorion epithelioma of the uterus have been reported many years after the menopause. The average time interval of its occurrence following full time pregnancy, hydatidiform mole and abortion are respectively 5 (Ladinski)<sup>7</sup>, 8 and 7 weeks (Ewing)<sup>7</sup>.

*Gross Pathology.*—The uterus in the present case was irregularly enlarged due to the presence of subserous fibromyomas in its wall. The malignant growth, i.e. chorion epithelioma appeared as a small, sessile, friable, haemorrhagic purple mass

adhering to the right wall of the uterine cavity near the isthmus and infiltrating its wall to a depth of 1.5 centimeters. This, however, is not the usual picture. The tumour is commonly seen near the fundus where the ovum normally lodges. It may be on the surface of the endometrium or deep in the uterine wall or bulging under the serous covering as a purple nodule. Lockyear places its primary site within the uterine musculature where it appears as a thrombus and later on invades and destroys uterine tissue as it extends towards the uterine cavity or the peritoneal surface. On the endometrial surface it presents in two other less frequent forms, viz. a diffuse type, only slightly raised above the surface; and a distinctly polypoid type, whose resemblance to placental polyp is very marked. A feature that marks it from benign conditions is its ability of rapidly filling up the uterine cavity after it is emptied with recurrence of symptoms.

Besides its softness, friability and freely haemorrhagic character, it has a great tendency towards degeneration and infection. The reason again lies in the tumour itself, i.e. the extreme, one-sided, outstripping proliferation of epithelial cells beyond its supporting stroma. The proliferated cells thus lose the blood supply of their own and become parasites on their host. They erode and enter the blood vessels and live on the blood which surround them. This causes bleeding which, if excessive, surrounds the cells. The malignant cells thus surrounded by organising blood are killed due to lack of nutrition.

The degenerated tumour with the necrosed tissues around it may break down causing excavating ulcers and even fistulae (Murray and Ahmed)<sup>8</sup>. Acosta-Sison<sup>1</sup> reported 3 cases where the uterus was perforated by the growth; the patients died of intraperitoneal haemorrhage resulting from the perforation.

Local extension may involve the peritoneum or the parametrium, travelling along the veins and appearing as a haema-

toma. But far more important and rapid is its progress by blood borne metastasis. Large quantities of chorionic gonadotropin from the rapidly growing trophoblast are probably responsible for the marked luteinisation in the ovaries which Novak<sup>9, 10</sup> called "hyperreactio luteinalis". It may involve either or both thecal and granulosa cells. The stage and duration of the intrauterine lesion appear to influence the type of response. Lutein cysts may be associated but the association is not constant, the frequency being about 50% (Frank). It appears from Brew's series that young age and hydatidiform mole predispose to the cystic change. These are retention cysts which do not destroy the ovarian tissue. The fluid contains luteal hormone and also gonadotropic hormone (Zondek and Philipp). The latter may give rise to pregnancy reaction for about 4—6 weeks or more after the removal of the tumour. Excessive luteinisation may lead to occasional decidual reaction in the endometrium.

*Histopathology.*—It is characterised by disorderly growth of the trophoblast tissue, usually in alveolar fashion, into the muscle, with its destruction and extensive coagulative necrosis as well as haemorrhage. The villous pattern is lost, and if present, it is only in traces (Meyer). Both layers of trophoblast are involved in varying degrees, and on their relative proportion depends Ewing's classification of the tumour into (i) chorioadenoma; (ii) choriocarcinoma and (iii) syncytial endometritis. There is a modern tendency to classify the tumour into different grades depending on the degree of anaplasia of the constituent cells. The above classification of Ewing has not only pathological but also relative prognostic value. By the presence of masses of Langan's cells with hyperchromatic, vesicular nuclei and mitotic figures, few islands of syncytium and complete absence of stroma, presence of big areas of necrosis and haemorrhage, the tumour under review conforms to the type which Ewing described as choriocarcinoma with a high degree of malignancy.

**Metastasis.**—This is common and early because the tumour actually invades and multiplies within the blood vessels and the tumour cells are disseminated through the blood stream. In this respect it resembles more a sarcoma than a carcinoma. Almost every organ of the body may be involved, most frequently the lungs, vagina, brain and vulva in that order.

The vagina and the vulva are affected more commonly by retrograde lymphatic spread. In Brew's series of 14 cases, 9 had pulmonary, 7 vaginal, and 4 cerebral metastases. The experience of Pollason and Violet<sup>7</sup> on a larger series is similar. A few authors, notably Fredrikson,<sup>7</sup> believe that metastasis is provoked by curettage and uterine manipulations. The rapid growth and generalisation of the malignant metastases of chorionic tissue suggest either a weaker resistance on the part of the host (Blair-Bell)<sup>7</sup> or absence of some element which is believed to be lytic to the chorionic tissues (Frankl<sup>7</sup>). Similarly rise of local resistance may be the cause of the spontaneous cure of metastases after the primary is removed—a phenomenon which defies easy explanation.

**Clinical Features.**—Uterine Bleeding after an abortion or following a confinement is the main symptom which is commonly seen. This is followed by symptoms which arise from degeneration and infection of the tumour projecting within the uterine cavity. This is often confused with a placental polyp or carneous mole. The next group of symptoms is due to secondary metastasis and peculiar to the site affected. At all places haemorrhage is the feature. In the lungs it causes haemoptysis. In the vagina and vulva it causes bleeding. This haemorrhage as it continues results in profound anaemia. Sepsis results in cachexia and toxæmia. Acosta-Sison<sup>1</sup> stresses on 3 features of the disease which he calls the HBE method—H represents a history of having expelled a product of conception; B, bleeding from the uterus, and E, enlargement and softening of the uterine corpus.

**Diagnosis.**—It is often very difficult. Its rarity, and the vague symptoms and signs in early stages constitute the pitfalls in diagnosis. One must be very alert and conscious of its possibility. "Malignant hydatidiform mole" closely simulates it and can only be differentiated histologically. Malignant moles keep a benign relationship with the uterine muscle and never invade or destroy it.

#### *Diagnostic Aids.*

**A. HORMONAL BIOASSAY:**—Fels and Rossler<sup>4</sup> first pointed out that the body fluid of patients with hydatidiform mole and chorionepithelioma contain chorionic gonadotropin in amounts far exceeding those of normal pregnancy. Zondek<sup>15</sup> on the basis of his earlier quantitative studies concluded that 5,000 to 30,000 m.u. per litre of urine are the limits for normal pregnancy. Over 50,000 m.u. per litre make the diagnosis of mole or chorionepithelioma likely. Recently he observed that the presence of increased amounts of follicle-stimulating hormone (Prolan A) is important in the diagnosis. Values up to 200,000 m.u. of this factor per litre of urine point to hydatidiform mole, but malignant degeneration is unlikely. When the values rise to 500,000 m.u. per litre, chorionepithelioma may be suspected, while values in millions make the diagnosis more certain. The presence of 400 m.u. of luteinising factor per litre of *spinal fluid* is also significant. Because of the importance in diagnosis of F.S.H. in the body fluids, he recommends the use of Ascheim-Zondek mouse test instead of Friedman's rabbit test, which detects only the luteinising factor.

The values in the blood in these conditions range from 2,000 to 333,000 m.u. per litre. In one case Zondek found 3,000,000 m.u. of F.S.H. per litre of blood and only 500,000 m.u. per litre of urine. This combination of high blood F.S.H. content with low urine F.S.H. is observed by him as diagnostic of malignancy. But the determination of blood F.S.H. is difficult and highly impracticable in ordinary practice.

The excretion of chorionic gonadotropin may persist for several weeks after mole delivery and about a week after normal pregnancy. If after this time, the hormone continues to be demonstrable or its concentration increases, chorionepithelioma may be suspected provided that a new gestation has been ruled out.

This test is also an aid to prognosis particularly after the growth has been removed. If repeated quantitative estimations reveal no chorionic gonadotropin, it may be assumed that the growth has been completely eradicated. Persistently high or rising excretion values point to recurrence and metastasis.

*Sources of Error.*—This test although highly valuable is not infallible. It gives false negative result in about 1.5% of cases. Again values comparable to those encountered in mole and chorionepithelioma have been reported in normal pregnancy. Conversely, a chorionic pathology may sometimes be associated with value equal to or below those of normal pregnancy. Low or negative values in cases of malignant chorionepithelioma with metastasis is recorded and is difficult to explain. Such errors emphasise the importance of repeated tests at intervals and also of interpreting the results of biological tests in the light of the history, physical findings and evidence yielded by endometrial curettage.

**B. DIAGNOSTIC CURETTAGE:**—Authorities are divided in their opinions about its usefulness. Some even condemn it as dangerous and liable to cause metastasis and perforation (Manhoff<sup>7</sup>, Fredrikson<sup>7</sup>, etc.). Moreover, there is difficulty in reaching an accurate diagnosis from curettage material which is often too degenerated to show any evidence of diagnostic value. Again, intramural tumour is beyond the reach of curetting and may give a faulty negative result. On the other hand, Zondek believes that diagnosis is not complete without curettage. In suspected cases it should always be done where biological test is not available or negative.

**C. BIOPSY OF THE TUMOUR:**—Only possible if it is in an accessible part.

*Prognosis.*—Diagnosis before there is metastasis and prompt treatment gives the best prognosis.

While in most cases it is highly malignant it is curious that in a certain proportion, nearly 10%, it may undergo spontaneous cure or cure after obviously incomplete operation, even in the presence of metastasis. Cases have been reported where secondaries disappeared after the removal of the primary uterine tumour (Loventhal<sup>7</sup>, Novak<sup>10</sup> etc.). Again the primary may disappear and patient may die of metastasis. These vagaries are difficult to explain.

The 5 year salvage rate as determined by Brews is 33.3%. Average duration of illness in his series is 8—13 weeks. Following full term pregnancy and abortion the prognosis is more serious. They are more often fatal than those following mole, since the diagnosis is usually unsuspected. In a recent series of 170 cases by Holman and Schirmer<sup>5</sup>, mortality rate was found to be 2.11%. This appears to be low considering the nature of the malady concerned.

*Treatment.*—The best treatment is radical surgery, viz. abdominal panhysterectomy. It should be done even in the presence of metastasis with the hope that secondaries may regress. As the progress of the tumour is mainly by blood stream, operation of Wertheim type need not be done. The patient is anaemic, toxic and resists operative shock poorly. She requires special preparation by blood transfusions. In extreme cases vaginal hysterectomy by clamp method is advised by Munro Kerr.

The chance of metastasis during operative manipulations are minimised by clamping the infundibulopelvic ligaments on either side after opening the abdomen.

Ovaries should always be removed. In this, conservative surgery is ideal but unsafe. Ovarian tissue may not be destroyed by excessive luteinisation or leutal cysts, but they may be the seat of a metastasis.



Moreover, climacteric symptoms that may follow can be relieved by estrogens, e.g. stilboestrol.

Again, in any case, the ovaries will atrophy within about two years after the hysterectomy.

Deep x-ray therapy should follow the operation. X-ray of the lungs should always precede the operation, since pulmonary metastases, if present, may be treated by deep x-ray therapy if recognised early. The vulva and vagina should be carefully examined for metastases.

**IRRADIATION THERAPY:**—It is a comparatively sensitive growth. Williams<sup>14</sup> reports 4 out of 6 cases treated by deep therapy who survived five years. Isolated metastases in the chest are worthy of treating by this method if the general condition permits. Intracavitary radium is out of the question in the presence of sepsis, necrosis and marked vascularity. It should never be preferred to surgery.

Treatment should be controlled by repeated estimation of chorionic gonadotropins by biological tests.

### Summary

(1) A case of Chorionic Carcinoma is reported.

(2) It is a highly malignant tumour which arises primarily from the chorionic epithelium and invades the uterus secondarily, causing necrosis and haemorrhage therein. It invades the blood stream and metastasies early along this route to distant places, commonly to the lungs.

(3) Its most peculiar aspect which helps greatly in its diagnosis is that it produces enormous amounts of chorionic gonadotropin which can be detected by biological tests.

(4) Uterine bleeding following a pregnancy state is the commonest symptom. In the absence of biological tests, microscopic examination of curette specimens helps in many cases towards its diagnosis. It must

be suspected and eliminated in all cases of bleeding following a pregnancy state.

(5) Panhysterectomy with bilateral removal of ovaries should be the operation of choice. Irradiation should be reserved for metastases in the lungs.

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## CASES & COMMENTS

### PAPILLARY CYSTADENOMA OF THE MALE BREAST

(with a case-report)

by U. MOHAN RAU, Madras.

The male breast is subject to all the different types of tumour formation that affect the female breast, but the incidence of tumours in the male breast is insignificant as compared with the frequency of their occurrence in that of the female. Of all neoplasms of the breast, 1% occur in males. Of this 1% of all tumours of the breast, cysts and papillomata are perhaps the least common, constituting only 1% of all the tumours in the male breast (i.e. about 0.0001% of all neoplasms of the breast, male and female, together).

**Clinical features.**—These tumours, known as “papillary cystadenoma” are usually situated near or underneath the nipple. One duct or many ducts may be affected. The lesion, generally circumscribed, rarely projects above the surface of the skin; but the skin may become adherent and the tumour may show a bluish tinge through the skin.

In about 75% of these tumours, there will be a “milky” or “sanguinous” discharge from the nipple. Pain may be present in about one-third of these cases. The axillary glands are not enlarged and these tumours generally are freely moveable at their bases and not adherent to the deeper structures.

**Age incidence.** These tumours have been reported at all ages varying from the 4th year of life upto the 82nd.

**On section,** these tumours show one or more cysts containing blood-stained fluid. From the walls of the cysts, single or multiple papillary epithelial growths project into the cavity. The fibrous connective tissue outside the cysts may undergo oedematous and hyaline changes

Nearly 40% to 50% of these tumours may undergo *malignant changes*.

**Treatment.** The principles that govern the treatment of cysts and papillomata in

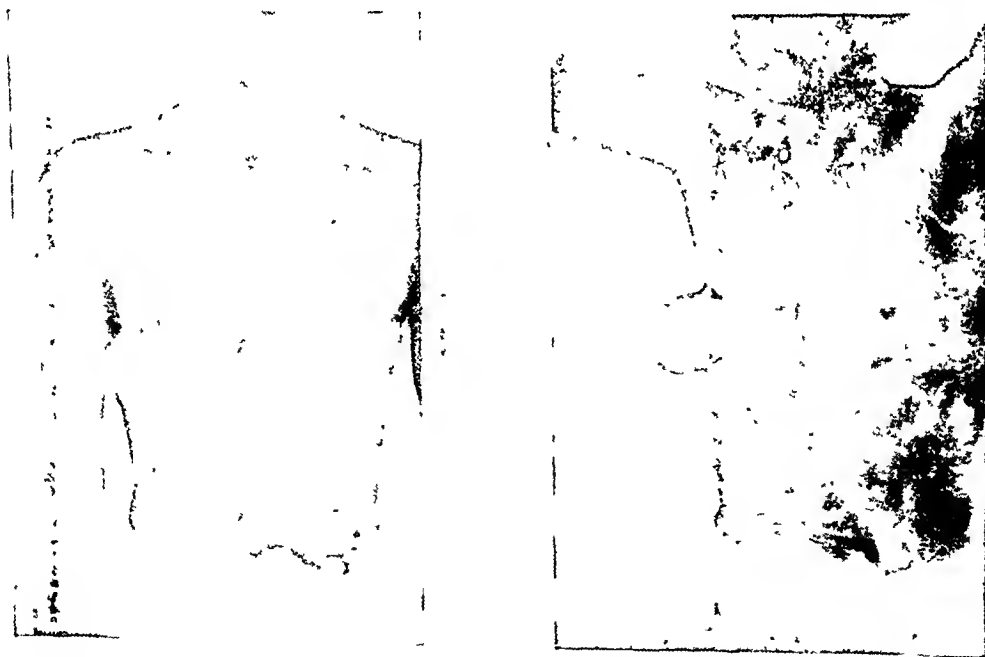


Fig 1 (a & b) Antero-posterior and lateral views (clinical photographs) of the patient.

\* From a Surgical Unit, Govt General Hospital, Madras.

the female, are to be applied also to the male.

### CASE REPORT

Kuppuswamy, M. Hindu, aged 40 years was admitted on 15-2-48 into the surgical wards of the Govt. General Hospital, complaining of a tumour in the region of the right breast.

**Clinical history.** This tumour had started as a small painless nodule about six months ago and had been gradually growing in size. It was painless before; but of late there had been some slight pain. There was no history of trauma to the diseased region.

On examination, there was a spherical tumour, about  $3\frac{1}{2}$ " in diameter, occupying the lower medial, lower lateral and upper lateral quadrants of the right breast (Figs. 1-a & 1-b). The entire subareolar region was occupied by the tumour. The skin was stretched out and shiny, and had a bluish discolouration. The nipple was not retracted and there was no discharge from it. This spherical mass was uniformly soft and cystic over its entire extent. Its margins were definite. It was attached to the region of the nipple and subareolar region, but not to the rest of the skin covering the mass or to the deeper structures. There was no warmth, no tenderness or irregularity over the tumour. The tumour was not translucent. The other portions of the same breast, the regional lymph-nodes and the opposite breast were normal.

A clinical diagnosis of a sebaceous cyst was made. The possibilities of the tumour being either a lymph-cyst with haemorrhage into it or a cystadenoma of the male breast were also thought of, but ruled out from the diagnosis on account of the extreme rarity of their occurrence.

**Treatment.** On 18-2-48, under general anaesthesia, the tumour was easily excised leaving behind the nipple and areola. The cystic mass was

rather avascular for its size. The patient had an uneventful recovery.



Fig. 3.

Section taken from the wall of the cyst showing carcinomatous infiltration.

**Microscopic appearance.** The excised mass was bluish in colour, about  $3\frac{1}{2}$ " in diameter and spherical in shape; it had no pedicle. The external surface was smooth and there was no evidence of undue vascularity. The wall appeared slightly indurated near the deepest portion.

On section (Fig. 2) thick sanguino-serous fluid came out from the cyst. The cyst wall was about 3 mm. thick and appeared to be smooth. Projecting from the deepest portion were a few papillomatous masses, some of which had narrow pedicles. The papillae were of unequal length and blunt ended. The rest of the inner aspect of the cyst appeared to be smooth.

**Microscopic Examination** (Dept. of Pathology, Madras Medical College). Appearances were typical of a papillary cystadenoma. There were evidences of the tumour having undergone a malignant change (? sweat gland carcinoma) (Fig. 3).

On 26-2-48, the patient insisted on going home, refusing to submit either to surgical or to irradiation therapy. No follow-up has been possible up-to-date.

### SUMMARY

A typical case of papillary cystadenoma of the male breast is presented.

### REFERENCE

"Tumours of the Breast" by Geschikter & Cope-land. Baillere Tindell & Cox, 1932.

I am thankful to the Superintendent for permission to publish this case report.



Fig. 2.

The cyst, laid open, to show the multiple papillomatous projections and the smooth inner surface.

# A CASE OF THYROID TUMOUR IN THE MAXILLARY ANTRUM

by P. P. CHANDU NAMBIAR, Madras.

A patient named M. Musaliah, aged 50 years, male, Hindu, labourer was admitted under my care, in King George's Hospital, Vizagapatam on 9-1-48 with a painless swelling over the left cheek (on the outer surface of the left maxilla). It started 2 years ago as a small nodule, the size of a Bengal gram. It gradually grew to its present size. Swelling was painless throughout. Eight months ago he was admitted into the Government Hospital, Chicacole where it was operated upon. According to the patient the tumour was not actually removed; only an incision was made. He was in Hospital for 8 months, during which time the tumour had been growing. He was discharged from there a month before his admission into this hospital.

## CONDITION ON ADMISSION

A moderately nourished individual of about 50 years whose general health was fairly good. A globular swelling about 2½" in diameter was present over the lateral aspect of the left maxilla extending from the lower orbital margin to the level of the angle of mouth below and from the ala nasi to the ascending ramus of the jaw laterally. There was a vertical scar over the swelling the result of a previous operation with a small ulcer at the upper end of the scar. The tumour had a soft elastic feel; it was not adherent to the skin, except at the ulcerated area. It was fixed to the deeper structures. No swelling was visible from inside the mouth, and the mouth could be opened to its full capacity. All the other organs were normal. There were two small nodules on both lobes of the thyroid; these were painless and freely moveable. He complained of pain in the upper part of the adductor muscles of the right thigh which he continued to complain throughout his stay in the hospital for nearly 8 months. But no cause could be made out for the cause of this pain, which was not very severe.

## INVESTIGATIONS

Urine, nil abnormal.

Faeces, nil abnormal.

Blood. Hb. 80%; W.B.C. 8000/CMM.

B.P. 105/75.

X-ray. Left antrum appeared opaque and expanded, with evidence of destruction of the outer bony wall. Picture was suggestive of a soft tissue tumour arising from the left antrum (Fig. 1).

On 17-1-48 under intra-tracheal ether anaesthesia, later replaced by chloroform, a preliminary ligature of the external carotid artery on the left

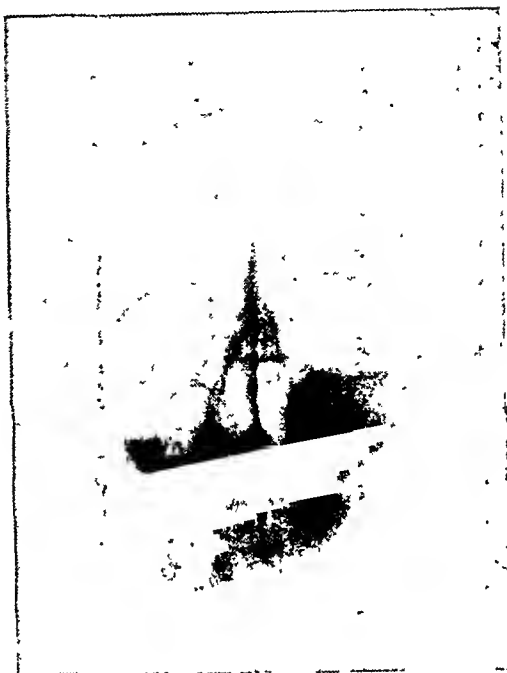


Fig. 1.

side was done. A transversely oval incision was made over the tumour and when dissected it was found that the tumour was a growth arising from inside the antrum. The lateral wall of the antrum had been completely destroyed by the growth. The tumour was removed. In spite of the ligature of the external carotid artery there was profuse bleeding. The wall was cauterised but the bleeding continued. The wound was therefore plugged with gauze and a firm bandage was put on, followed by intravenous calcium gluconate and intramuscular "Coagulen", which controlled the bleeding. Convalescence was uneventful.

*Pathology report* by Dr. T. Bhaskara Menon (21-2-48). "The tumour has an appearance of thyroid tissue. Thyroid may be examined for any nodule." A microphotograph of the tumour is shown in Fig. 2.

On 7-3-48, the small nodule on the right lobe of the thyroid was removed and sent for examination by the pathologist.

The report (by Dr. T. Bhaskara Menon) "The material sent shows adenomatous nodule of microfollicular type." (Fig. 3.)



Fig. 2.

As saliva was flowing from the wound the patient was again anaesthetised (intratracheal ether) on 10-3-48, the skin edges were excised and the wound sutured. There was profuse bleeding this time also. The fistula was converted into an internal one. 10-4-48. Sutures did not take. On 30-6-48 under local 1% novocain an attempt was made to suture the wound again but it failed on account of profuse bleeding. On the 19th of July 48 the nodule on the left lobe of thyroid was removed under local anaesthesia and sent for pathological examination. Pathological report by Dr. Bhaskara Menon:—

"Nodule shows areas of acini containing colloid, some vesicles showing activity and some showing no secretion. Tissue sent does not contain any tumour tissue."

It may be stated that the patient had never noticed any nodule in the thyroid himself nor had he any pain at any time.

### Discussion

The question now is whether the growth in the antrum is a metastasis. If it is a metastasis it must be malignant. The pathological examination of the tumour in the



Fig. 3.

antrum as well as the nodules in the thyroid do not suggest that any of them is malignant.

Dunhill in his Arris and Gale lecture delivered at the Royal College of Surgeons in February 1931 and published in the *British Journal of Surgery*, Vol. XIX lays down that it is difficult to say where malignancy begins in the thyroid. He says that the criteria of malignancy sometimes rest not on the character or arrangement of cells, but pathologically on such evidence as invasion of the capsule and inclusion of vessels and clinically on local recurrence and metastasis. The former were not found here but the latter was present. Any way it is rare to find thyroid tumour in the antrum, metastasis or otherwise, and hence this case report.

I have to thank Dr. M. V. Ramanamurthy, Superintendent K. G. Hospital for kindly permitting me to publish the case.

# A CASE OF ANTERIOR DISLOCATION OF THE ELBOW

by P. P. CHANDU NAMBIAR, Madras.



Fig 1.



Fig. 2.

Anterior dislocation of the elbow is an extremely rare condition. So far as I am concerned this is the first case that I have seen in my practice of 35 years.

## CASE REPORT

A patient named Sathyam, Hindu, male, aged 28 years was admitted on 18-4-47 under my care, in an unconscious condition in K. G. Hospital with multiple injuries all over his body and a swelling over his right elbow. He recovered consciousness partly the next day, but he was unable to give any details regarding the injuries or nature of the accident. His right elbow showed a swelling with a prominence on the anterior and lateral aspect of the humerus. On palpation it was found that the olecranon process and the head of the radius were lying in front and to some extent laterally. X-ray confirmed the clinical findings (vide Figs 1 & 2). Fig 3 is the clinical photograph of the elbow. He had radial palsy.

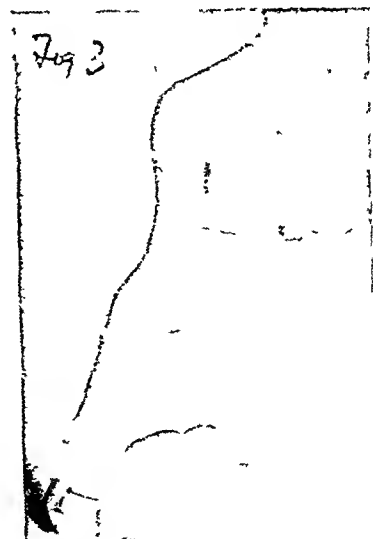


Fig. 3.

On 15-5-47 under general anaesthesia the elbow joint was exposed through a Kocher's incision, as manipulation failed to reduce the dislocation. The triceps was split and retracted. The ulnar nerve was found displaced laterally and lying between the external condyle and the olecranon. Even at this stage the attempt at reduction failed. With a little more clearance of the tissues the olecranon and the head of the radius were brought down to their normal position and the ulnar nerve was re-

placed in its groove behind the medial condyle. The limb was encased in plaster of paris with the elbow at right angle. Radial nerve palsy did not improve. The patient whose mental condition was aberrant since the accident, absconded and hence the radial nerve palsy could not be dealt with.

I have to thank Dr. M. V. Ramanamurthy the Superintendent K. G. Hospital for kindly permitting me to publish the case.

## REVIEWS OF BOOKS

**Surgery: Orthodox and Heterodox**, by Sir William Heneage Ogilvie: Blackwell Scientific Publications, Oxford, 1948. Pp. 241, Illustrations 30.

This is a collection of articles contributed by the author at various times to various journals. It covers a wide range of subjects related to surgery and is written in a style which is clear, simple and direct. The author's essentially rational and sound attitude towards the problems of a surgeon's life is reflected in his writings. The experienced surgeon will find in this book much that he has always agreed with, the beginner, many things that will lead him in the right path towards his goal. The book should find an honoured place in the library of every one who is interested in the healing of the sick and the suffering and, we are sure, will rank among such classics as the "Aequanimitus" of Sir William Osler. Sir William Heneage Ogilvie is a great surgeon and a great author.

C. P. V. M.

**Recent Advances in Surgery**: by Harold C. Edwards: J. & A. Churchill Ltd., London, 1948. Pp. 437, Illustrations 131.

In the third Edition of this book, coming nearly 20 years after the second, Mr. Harold C. Edwards has kept up the excellent standard set by his predecessor Sir Heneage Ogilvie. The great advances made in the last two decades have been summarised and lessons learned during the Second World War in the resuscitation of shocked patients and the treatment of war injuries have been incorporated. In the section on thoracic surgery contributed by Mr. R. C. Brock, the great advances made in recent times in the surgery of the heart and in the treatment of bronchial carcinoma have been described. D. W. C. Northfield has given a good account of some of the recent developments in the field of neuro-surgery and Stanford Cade has given a complete review of the present position of Radiotherapy in the treatment of malignant

disease. The book will be of great use to those who have been too busy to keep up with current literature. We hope that future editions will appear at more regular and frequent intervals.

C. P. V. M.

**An Atlas of Traumatic Surgery** by Josep Trueta 1949. Blackwell Scientific Publication, Oxford. Pp. 150, Illustrations 188.

This book is a record of case notes and clinical photographs of forty cases suffering from serious compound fractures and large wounds of the extremities. All these cases were treated by the now famous procedure, which was introduced and developed by its experienced author both during the Spanish Civil War and later at the W. M. Orthopaedic Hospital, Oxford during the Second World War. These records are all the more valuable because all photographs (188 in number) are untouched and the day to day clinical notes have been left as written by the surgeon at the time when the wounds were examined.

The developmental history of this novel and revolutionary method of treatment from its infancy in July 1936 to its present well recognised form is surveyed by the author in the introductory part of the book. Further, besides giving the principles of treatment, proper emphasis is laid on the fact that there is no substitute for effective surgery. "If surgical treatment is good, the result will be good. If surgical treatment is bad, neither sulpho-namides nor penicillin will atone for the error". The author expects and rightly so too, that this method will offer even better results in peace-time injuries than in injuries due to War, as the former are less destructive than the latter.

Every surgeon must have his library enriched by a copy of this work and none, whatever his standing, can ignore the lessons it teaches.

U. M. R.

## ASSOCIATION NOTES

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#### The XI Annual Conference

The XI Annual Conference of the Association of Surgeons of India will be held at the Madras Medical College during the last week of December, 1949. All members are requested to attend.

#### Subjects for Discussion

The following are the subjects for discussion at the XI Annual Conference of the Association of Surgeons of India to be held at Madras during December, 1949.

#### 1. Treatment of Elephantiasis and Lymph Oedema—

Opener : Dr. V. P. Mehta, Bombay.

Seconder : Dr. T. Kanakaraju,  
Ramachandrapuram.

#### 2. Treatment of Hernia with Fascial Grafts and Silk Sutures—

Opener : Dr. P. Chatterjee, Calcutta.

Seconder : Dr. S. K. Datta, Calcutta.

#### 3. Treatment of the Bone Cavities in Chronic Osteomyelitis—

Opener : Major D. K. Sabhesan, Madras.

Seconder : Dr. B. N. Sinha, Lucknow.

### SHORT PAPERS

In addition to these, members are requested to present during this Session, "Short Papers".

(i) Any subject of interest to the surgical profession can be selected for a Short Paper.

(ii) Each paper should not exceed a maximum of 15 minutes.

(iii) Apart from questions, no discussion is allowed on these papers.

(iv) Copy or copies of this paper may kindly be sent to the Hony. Secretary, Association of Surgeons of India, 207, Poonamallee High Road, Madras 7, before the 30th of September, 1949.

Members are requested to take part in the presentation of these Short Papers and make the Conference one of maximum benefit to all present.

#### Subjects for discussion at future meetings

##### 12th Meeting :

#### 1. (a) Bronchiectasis—

Dr. R. Mahadevan, Madras.

#### (b) Lung Abscess—

Dr. S. J. Mehta, Bombay.

#### 2. Intestinal Obstruction in Children—

Opener : Dr. A. E. DeSa', Bombay.

Seconder : Dr. R. A. Irani, Bombay.

#### 3. Sciatic Syndrome—

Opener : Dr. S. K. Sen, New Delhi.

Seconder : Dr. V. P. Mehta, Bombay.

##### 13th Meeting :

#### 1. Hydrocephalus—

Opener : Dr. A. E. DeSa', Bombay.

Seconder : Dr. S. K. Sen, Delhi.

#### 2. Prolapse of the Rectum—

Opener : Dr. K. G. Munsif, Bombay.

Seconder : Dr. S. N. Mathur, Lucknow.

#### 3. Tuberculosis of the Hip Joint—

Opener : Dr. A. K. Basu, Calcutta.

Seconder : Dr. B. N. Sinha, Lucknow.



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# THE INDIAN JOURNAL OF SURGERY

Vol. XI

SEPTEMBER 1949

No. 3

## INJURIES AT THE ANKLE AND THEIR MANAGEMENT\*

A. K. SAHA, *Calcutta.*

Pott or Pott-Dupuytren fracture is used as a generic title to embrace those fractures of the lower ends of the tibia and fibula which lead to a disturbance of the mechanics of the ankle joint (Robert Jones). It is not infrequent to find recurrent ankle disabilities ranging from mild-est recurrent sprains and/or traumatic adhesions to more severe deformities—results of fracture-dislocation of the ankle. This state of affairs is due to:

(1) Inapt nomenclature—easy though not so practical, sub-divisions of fracture-dislocations without laying importance on the almost infinite varieties of mechanisms—and on the treatment which should be based entirely on the findings of a particular case. If one treats a series of fractures of the ankle, he would rarely find two exactly similar fracture-dislocations, and that way they would be comparable to human faces—no two being exactly similar. This is contrary to popular view and will be apparent from a representative quotation of R. Broomhead of the Leeds Orthopaedic School—"Fracture dislocations of the ankle joint are usually the results of forces applied in certain definite and well-defined directions; the application of each particular force causes a typical fracture or fracture-dislocation."

(2) The awe with which one takes this group of injuries, with the result that

there is more often over-treatment where no treatment is indicated, and none or little care where utmost skill and follow-up are the essentials for a successful outcome.

### Anatomy of the Ankle Joint:—

A few points in the anatomy of the joint will not be out of place in this connection. It is a hinge joint. Movement is possible in the antero-posterior plane through a range of 70° to 140°. In dorsiflexion there is widening of the malleolar distance by 2 to 3 mm., as the 25% wider front part of the talus engages the similar though less wide tibio-fibular articular surface. The joint surface configuration and statics during all stages of erect posture are so wonderfully balanced that, at the limit of permissible motions, the bony guards have little to check further movements. Inversion and eversion which take place at the subtaloid joint demand strengthening on either side of the ankle joint. The deltoid and external lateral ligaments with their three bands have, therefore, been developed. Further, the inferior tibio-fibular joint is strengthened by anterior and posterior ligaments; and the interosseous ligament, the proper bond of union, is the continuation of the interosseous membrane. The inferior transverse ligament is the continuation of the posterior tibio-fibular ligament.

Alteration of Joint Mechanics:—A. Disturbance in relation to the arti-

\*Read at the Indian Medical Association (Calcutta Branch) on 22nd June, 1949.

cular surfaces at the ankle joint level, i.e., point to point incongruence of the articular surfaces. Persistent or recurrent shifts, tilts and rotation of talus will give rise to weakness, occasional giving way and final degenerative osteo-arthritis of the joint.

B. Disturbance of the weight bearing alignment at the supra-malleolar level. i.e., the ankle joint space is in abnormal relation to the limb and other joints, as a component of the weight transmitting axis. This may be evident as shifts, overlap, tilts and rotation round a vertical axis. This is of great importance in treating supra-malleolar fractures which necessarily, according to first principle, should be grouped along with the Pott-Dupuytren fracture-dislocation.

**Diagnostic and Check-up Methods after Reduction for Evaluation of Joint Mechanics:** A. *Clinical*: The foot in plantigrade position shows normally that (a) the tibial tubercle and the second toe are in the midsagittal plane, as seen from the front; (b) the head of the fibula, the lateral malleolus and the junction between the middle and the posterior  $\frac{1}{3}$ rd of the outer border of foot from the heel to Jones' tubercle are in a vertical plane as seen from the lateral aspects; (c) the joint is moveable through  $70^{\circ}$ — $140^{\circ}$  range and this is a check-up for supra-malleolar antero-posterior tilts in otherwise healed fractures with malunion.

B. *Radiological*: Shifts and tilts are diagnosed from good lateral and a.p., views. Rotation is discernible from both a.p., and lateral views. In an antero-posterior view, we find double contour of the medial malleolus and less overlap of the tibial border on the fibula. In the lateral view the dis-

tance between the lateral and the medial malleoli is diminished. A good lateral view should give a single talus outline.

It is quite reasonable to assume that under some particular stress where both ligament and bone are liable to snap, the latter usually gives way.

No age is exempt from injuries at the ankle, though these are more common amongst male athletes. Prancing boys with characteristic varus deformity due to premature epiphysal fusion are not uncommon (from old adduction fractures, i.e., railing fractures).

**Mechanism of injury:** Direct and indirect strains are responsible.

A. *Direct*—includes those where a wheel passes over the outer side of the ankle joint. This is the most common form of injury.

B. *Indirect*—may include almost an infinite variety of strains, but, for elucidation of the mechanisms, seven primary strains have been recognised.

Minor degrees of these strains bring about strained ligament and/or partial tears in so-called **strong ankles** (skier's).

1: **EXTERNAL ROTATION**—may occur with variable amount of flexion at the ankle. The stress tends to separate the leg bones by a twisting force.

*Examples—Leg fixed:*

- (1) Walking or running on uneven ground.
- (2) Stepping into a hole while running.

*Foot fixed:*

- (1) Turning to one side suddenly.

- (2) Going downstairs—if the advancing foot fails to take a step, the rear foot being fixed, the leg rotates inwards as he falls.

A minimal rotation strain results in spiral fracture of the external malleolus. The fracture occurs in such a way that the lower fragment retains the attachment of the bands of union of the inferior tibio-fibular joint, specially the interosseous ligament. Rarely, the anterior tibio-fibular ligament may rupture. In the latter case a twisting fracture of the fibular neck may occur.

The fracture plane of the ext. malleolus is directed forwards and outwards. No displacement occurs in this isolated fracture. Further degrees bring about stresses developing at the medial part of the joint. Thus either the deltoid ligament gives way or the medial malleolus sustains an avulsion fracture of variable size, but never above the ankle joint level.

The foot is displaced outwards with its attached malleoli and is rotated outwards with tilt. Rarely the tibia is fractured above the joint by the same twisting force (Fig. 1).

More severe injuries develop stress at the interosseous band which very rarely snaps by this twisting force (diastasis); but it usually brings about avulsion fracture of that part of the tibia to which it is attached. (The fracture-line of the tibia looks as if it is the continuation of the fibular fracture plane). This fragment is described as posterior malleolus and is never more than a third of the total articular area for obvious reasons (posterior malleolar fracture of Watson-Jones). If weight is borne, the foot is displaced posteriorly and upwards besides its outward shift and tilt.

*Children:* The above strain in children may bring about the same type of



Fig 1.

External rotation fracture with spiral fracture of lateral malleolus and spiral fracture of lower third of tibia (arrow)



Fig 2

Spiral fracture of tibia above the ankle joint in a child.

fracture dislocation, but more often the metaphysis gives way, the foot is displaced outwards, backwards and upwards with a triangular diaphysial fragment from the postero-lateral side of the tibia.

Supramalleolar fracture due to external rotation strain with intact epiphysis and ankle joint, is not uncommon, though the level of fracture is not always constant. (Figs. 2 and 3).

(2) ABDUCTION STRAIN: The foot is directly bent outwards at the ankle.

*Examples: Leg fixed: walking or running on uneven ground.*

*Foot fixed: Bumper crash or player falling on outer-side of the leg just above the ankle joint level.*

A minimal injury results in torn medial collateral (deltoid) ligament or an avulsion fracture (never above joint level) of the medial malleolus without any displacement of the foot. More severe injuries may, in addition, result in one or more of the following:—

(a) Fracture of the lateral malleolus—by attachment at joint level (shearing fracture dislocation of Perkins, bimalleolar fracture dislocation of Ashhurst). The fracture being below the attachment level of the interosseous band, the foot with the attached malleoli is displaced outward.

(b) Detachment of the lateral tibial attachment of the interosseous band with varying amount of the adjoining tibia; displacement same as above.

(c) Torn interosseous ligament without any bony injury (diastasis). With intact medial malleolus the space between it and the body of the talus is increased. (Fig. 4).

(d) Fracture of the fibula at a variable height usually 3" to 4" above the tip of the lateral malleolus with diastasis of the inferior tibiofibular joint, inward angulation of the fragments and separation of a "butterfly", small, triangular piece on the outer side (fracture characteristic of angulatory stress). Same dis-



Fig. 3.

Spiral fracture of tibia in a child due to external rotation strain.



Fig. 4.

Avulsion fracture of medial malleolus and diastasis of inferior tibiofibular joint. Marked lateral displacement is present. (abduction strain).



Fig 5

Fracture of medial malleolus, diastasis of the inferior tibiofibular joint and fracture of fibula at characteristic level. Displacements described in the text are seen.

placement as above and clockwise tilt in coronal plane. (Fig. 5.).

Severest injury in addition to the above or in the absence of the above may break both the tibia and the fibula at the waist, immediately above the ankle with valgoid deformity (supramalleolar fracture—abduction type).

#### Children :

- (a) Whole tibial epiphysis may be displaced outwards with the foot.
- (b) The interosseous band may snap off a fragment of the epiphysis (comparable injury as (b) in adult).

#### Compound :

Injury with bursting from within by the lower end of tibia and fibula on the medial side with gross displacement is occasionally seen. This is more often associated with bumper crash or direct injuries.

3. INTERNAL ROTATION: Similar mechanism as in external rotation strain

but the direction of stresses and their effects are exactly reverse; either, the leg rotating out on the fixed foot or the foot rotating in on the fixed leg. Fracture-dislocation is difficult though not impossible with this pure type of strain owing to the massive nature of the lower end of the tibia: though in plantarflexion, this, with varying amount of adduction strain (to be described next) is responsible for a series of ligamentous strains, tears and talus dislocation, the last being beyond the scope of our present discussion.

4. ADDUCTION STRAIN: In a plantar-flexed foot, this with internal rotation brings about conditions just alluded to. In a normally standing foot or a dorsiflexed foot, it causes a series of fractures and/or dislocations.

#### Examples :

*Leg fixed :* (1) Worn out heels on the outer side helps adduction strain.

- (2) Bumper crash against right lower leg may cause adduction strain in left ankle.

*Foot fixed :* Running or walking on uneven ground or stepping into a hole etc.

With a lax foot i.e., a foot with ability to turn in to an angle of  $90^\circ$  (Bonnin 1944), minor degrees result in vertical fracture of the medial malleolus. The fracture face is almost vertical and is placed sagittally without any spiral twist whatsoever. This is believed to be due to a chisel action (Watson-Jones) by the medial upper border of the talus and no part of the tibial plateau is taken with the medial malleolus as a rule. (Fig. 6).

- (a) The twist in the fracture face showing a double line of fracture in an anteroposterior skiagram, and (b) The taking up of variable amount of tibial plafond either anteriorly or posteriorly are invariably associated with additional rotation strain (usually of the internal variety). (Fig. 7).

A vertical compression strain may result in a comminuted fracture of the affected tibial plateau in addition.

With a normal type of foot, the external malleolus first suffers avulsion fracture at or below the joint level. No displacement in either of the above types of injury is found. More severe injuries combine both the above, and the question as to which came first is not of much importance. The displacement is medialwards with an anti-clockwise tilt of the foot with attached malleoli round an anteroposterior axis. The severest injury leads to a supra-malleolar fracture, exactly reverse of the type due to abduction strain, already described.

*Children.* Railing fracture corresponds to the fracture of the medial malleolus just described. The whole foot with the lower epiphysis may be displaced inwards with a triangular piece from the tibial diaphysis on the medial side. (Fig. 8).

#### Compound :

Compound fracture dislocations are common as in abduction strain and are mostly due to direct injury.

#### 5. VERTICAL COMPRESSION STRAIN :

Body weight acting on the foot e.g., vertical fall from a height.

The momentum of the falling body weight flexes the ankle dorsalwards (nor-



Fig. 6.

First degree adduction fracture of medial malleolus. Fracture face is typical and no part of tibial plateau is involved

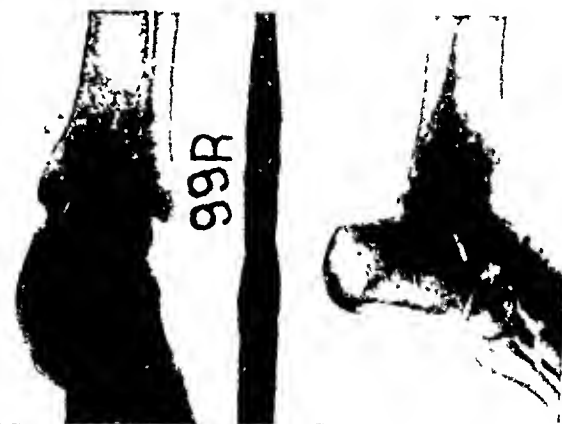


Fig. 7.

Spiral twist of the fracture face as seen by double lines suggests mixed adduction strain with internal rotation.



Fig. 8.

Adduction fracture (1st degree) in a child-railing fracture.



Fig. 9.

Old comminuted fracture of body of talus (vertical compression strain).



Fig. 10.

Vertical compression injury with comminution of anterior portion of tibial plafond. The nature of fracture of medial malleolus suggests superimposed adduction strain.

mally the line of gravity is just in front of transverse axis of the ankle in standing) and thus pushes the broader anterior part of the talus against the narrower posterior part of the tibiofibular articular surface. The following are thus the possibilities:

- (i) Comminuted fracture of the body of the talus affecting the ankle joint mechanics. (Fig. 9).
- (ii) The vertical momentum may break the anterior part of the tibial plafond with forward and upward displacement of the foot. The fragment is usually bigger than  $\frac{1}{3}$ rd of the articular surface. (Fig. 10).
- (iii) Tibiofibular diastasis with backward and upward dislocation, the fibula retaining attachment with the foot.
- (iv) Breaking of the malleoli and splaying, due to shear, showing small triangular pieces externally.

(v) Talus forced between the two bones after diastasis of the joint.

(vi) Lower end of the tibia sustaining comminuted fracture, rarely combined with a supramalleolar type as in abduction/adduction injuries or a T-fracture of the lower end of the tibia. (Figs. 11 and 12).

#### 6. FORWARD AND BACKWARD STRAINS :

Usually the foot is caught in a hole while running; in a stirrup, while riding a horse; or in a grid. in children; when either the moving body or the falling body weight determines forward or backward dislocation. It may also happen when a patient is caught by the heel while going downstairs. A rarer type occurs where the foot is fixed and the bumper of a car crashes against the back of the lower leg. More often these are combined with other stresses.



- (a) The twist in the fracture face showing a double line of fracture in an anteroposterior skiagram, and (b) The taking up of variable amount of tibial plafond either anteriorly or posteriorly are invariably associated with additional rotation strain (usually of the internal variety). (Fig. 7).

A vertical compression strain may result in a comminuted fracture of the affected tibial plateau in addition.

With a normal type of foot, the external malleolus first suffers avulsion fracture at or below the joint level. No displacement in either of the above types of injury is found. More severe injuries combine both the above, and the question as to which came first is not of much importance. The displacement is medialwards with an anti-clockwise tilt of the foot with attached malleoli round an anteroposterior axis. The severest injury leads to a supra-malleolar fracture, exactly reverse of the type due to abduction strain, already described.

**Children:** Railing fracture corresponds to the fracture of the medial malleolus just described. The whole foot with the lower epiphysis may be displaced inwards with a triangular piece from the tibial diaphysis on the medial side. (Fig. 8).

#### Compound:

Compound fracture dislocations are common as in abduction strain and are mostly due to direct injury.

#### 5. VERTICAL COMPRESSION STRAIN:

Body weight acting on the foot e.g., vertical fall from a height.

The momentum of the falling body weight flexes the ankle dorsalwards (nor-



Fig. 6.

First degree adduction fracture of medial malleolus. Fracture face is typical and no part of tibial plateau is involved.

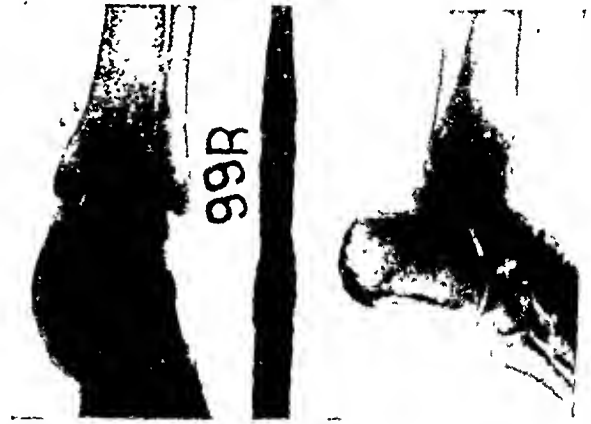


Fig. 7.

Spiral twist of the fracture face as seen by double lines suggests mixed adduction strain with internal rotation.



Fig. 8.

Adduction fracture (1st degree) in a child-railing fracture.

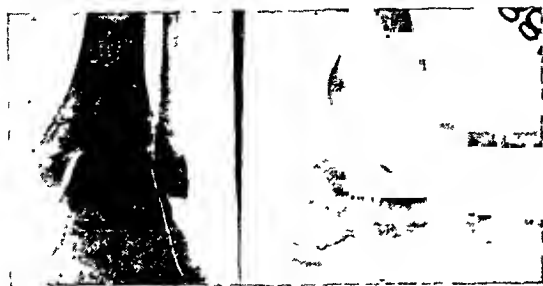


Fig. 15.

Avulsion fracture of medial malleolus with complete diastasis of the inferior tibiofibular joint (abduction strain). Posterior malleolar fracture is due to backward thrust of foot.



Fig. 17.

Adduction fracture (2nd degree). Combined internal rotation has resulted in taking a piece of adjoining tibia (arrow) along with the medial malleolus.



Fig. 16.

Adduction fracture (1st degree) in a child. The fracture of the body of the talus is due to vertical compression of falling body weight.

Compound stresses are too numerous to be described individually. The commoner varieties are mentioned with available skiagrams.

(1) Adduction and external rotation. (Figs. 13 and 14).

(2) Abduction and backward thrust as the body tends to fall forward. (Fig. 15).

(3) Adduction and vertical compression of the falling body weight (internal rotation may be present). (Fig. 16).

(4) Adduction and internal rotation may combine. (Fig. 17).

Skiagrams of 32 patients from the Calcutta Medical College and the R. G. Kar Medical College with ankle injuries during the period 1948 were examined. There has been no selection and all the skiagrams available were included. (Tables I & II).

TABLE I

Strain	No. of Pts.	% of Total
Pure	25	78.1
Mixed	7	21.9
Total	32	100



Fig. 11.

Vertical compression strain producing comminuted supramalleolar fracture; the ankle joint proper is not involved.



Fig. 12.

Vertical compression with a certain amount of adduction strain producing supramalleolar comminuted fracture and fracture of adjoining portion of talus where medial malleolus impinges.



Fig. 13.

External rotation and adduction strains are combined to produce spiral twist of the supramalleolar fracture and commencing external malleolar avulsion fracture on the outside (arrow) with unaltered talo-medial malleolar interval.



Fig. 14.

Adduction and external rotation strains are combined.

always bear a grave prognosis. No matter how perfect the restitution of the articular surfaces is, degenerative arthritis and its consequent effects necessitate early arthrodesis, specially among the aged.

GROUP IV—Open fracture dislocation from within always have a better prognosis than open wounds from direct crash. There is less contamination in the first group of injuries.

GROUP V—Fracture-dislocation and epiphysal separation in children—

(a) The prognosis is always good, provided replacement is accurate and is done early. There is no growth disturbance in epiphysal separation with pure shearing or rotational or angulatory strains. The separation takes place through the metaphysis. Such epiphysal separations show the well-known triangular diaphysal fragment from the concave side of the strain. (Angulatory or rotational strains only).

(b) Growth disturbances occur where some portion or all of the epiphysal cartilage plate is vertically compressed. This results in haemorrhage in the metaphysis with herniation of incompressible cartilage amidst broken and disorganised newly formed fragile trabeculae. This

is held responsible for premature disappearance of the epiphysal plate.

(c) The prognosis for comminuted fracture-dislocation is slightly better than in adults owing to the high remodelling capacity of early life.

So far we have dealt with fracture-dislocation from a purely academic standpoint. Only uni-directional and more commoner bi- or poly-directional strains have been mentioned. There may be rarer bi-directional or poly-directional strains acting on a joint and the resulting fracture-dislocation may not quite look like what has been outlined in our brief discussion. Simplification into four groups, e.g., external rotation, abduction, adduction and vertical compression types, in the manner Ashhurst has done, appeals to everybody and is useful to a beginner, but every surgeon who has done a few of these cases will confirm that this is hiding facts in an attempt at oversimplification. The older surgeons recognised this and though they did not assert (at least I have not found any reference in literature) the possible infinite varieties of fracture-dislocations, yet they have recognised the seven primary strains to cause fracture-dislocations just outlined (Key & Conwell). An average surgeon should know all possibilities and his knowledge is thus made all-embracing and elastic, though it is excusable if he is unable to remember everything on the spot. What he is concerned with about his patient is his (patient's) recovery. All the above are not necessary from the patient's point of view. It may be asked from the surgeon's standpoint—"How then should we be guided?" "Entirely from what is found in



by the other palm at the other side of the foot just below the ankle, the fingers grasping the heel. Right or left hand in suitable position is adjusted depending on whether he is manipulating a medial or lateral displacement in the right or left foot. The position of the leg may be hanging over the edge of the table in front of the surgeon, who is seated on a stool. Maximum force should be applied, as there is no fear of over-reduction except in bi-malleolar shearing fracture-dislocation where cautious manipulation is needed. If unsuccessful in cases of comparatively older fracture-dislocation, the correction is done over a wooden wedge (Lorenz-fulcrum) just above the ankle. Body weight of the surgeon may be usefully commissioned for this correction.

*Posterior displacement and tilt:* Correction is done preferably by Robert Jones' method. Counter-pressure by a broad linen band across the shin and the loop

held by the surgeon's foot allows adequate upward pressure to be maintained by both hands at the heel. The knee of the patient should be flexed over the cross bar of Bohler's frame or held by an assistant, and ankle plantar-flexed if necessary to relax the pull of the gastrocnemius and the soleus. If other displacements are present as well, they may be usefully corrected by one palm at the heel and the other facing the direction in which correction is necessary. (Fig. 18).

*Anterior displacement and tilt:* Reverse of Robert Jones' manouvre with the counter-pressure band over the patient's calf and round the surgeon's back serves admirably. (Fig. 19).

*Upward displacement with or without splaying of the malleoli with comminuted fracture of the lower end of the tibia:* e.g., supra-malleolar compression fracture;

- (1) Pull in the axis of the limb with the help of Steinmann's pin



Fig. 18

Method of manipulation for correction of backward displacement.



Fig. 19.

Method of manipulation for correction of forward displacement.

through the heel may be necessary.

- (2) Firm pressure over both padded malleoli with the palms of both hands or Bohler's clamp to restore the correct width of the ankle.

**MAINTENANCE AND IMMOBILISATION :**  
After thorough check-up radiologically for perfect reduction, as no half-way house can be entertained, a plaster cast is applied over light cotton wool padding. Careful check-up of position after two to three weeks when oedema and swelling have subsided and replacement by an unpadded cast is necessary. Non-weight bearing is preferred till a skin tight plaster can be ensured to hold the position. A third plaster at the end of five to six weeks ensures better retention. Total period of immobilisation is continued for twelve weeks.

#### PROTECTION :

1. Prevention of recurrent gravitational oedema by elastoplast strapping for four weeks.
2. Short iron with T-strap, the iron being on the side of the original deformity and/or crooked and elongated heel designed to neutralise the deforming forces of walking and weight bearing.

Full functional restoration is done after four months from the onset. Manipulation may be needed for the foot and ankle if there be persistent ache due to adhesions.

#### III. OPERATIVE TREATMENT AS AN ALTERNATIVE, OR AS A METHOD OF CHOICE :

The indications and the type of operation are outlined as follows :—

1. Interposition of soft tissues in malleolar (medial) fracture with wide gap persisting after attempted reduction and non-union is feared. Screwing after raising the interposed tissues and freshening of the fracture surfaces is the method of choice.
2. Tibiofibular diastasis: recurrence of displacement after manipulation and plaster, is almost certain. Screwing through-tibia and fibula taking care to drill through the central portion of both tibia and fibula is preferred.
3. Anterior and upward displacement with fracture of anterior 2/3rd or more of the lower end of the tibia and posterior and backward displacement with fracture of posterior 1/3rd or less of the lower end of the tibia. Screwing after freshening the fracture surfaces is ideal. In order to avoid death of the fragment too much stripping should not be done.
4. Gross comminuted fracture of articular bearing surfaces specially in the aged, where no matter how perfect reduction is attained, degenerative osteo-arthritis is inevitable.  
Operative fusion of the joint is undertaken in such cases.

#### IV. OPERATION IS THE EXCLUSIVE METHOD OF TREATMENT :

Maltreated and untreated fracture-dislocations and inevitable or avoidable complications, such as,

- (1) Degenerative arthritis due to faulty reduction and persistence of unrecognised deformity (avoidable).

- (2) Too much comminution of articular surfaces, e.g., fracture of the talus and lower end of the tibia specially in the aged and consequent certainty of degenerative osteo-arthritis (inevitable).

These need operative arthrodesis of the ankle joint.

- (3) Compound fracture-dislocation (inevitable): Excision of the wound and treatment on the same plan as for fresh wounds.

*Arthrodesis of the ankle:* Approach, after oblique osteotomy (with lower fragment—bevelled outward) of the fibula and complete dislocation of the ankle gives excellent exposure. Careful removal of all cartilage-bearing area is done. A screw or a bone graft through lateral malleolus and talus to ensure perfect contact of raw surfaces is used. Bone chips to fill the crevices left, give early fusion.

*Causes of deformity of maltreated or untreated fracture-dislocation:*

1. No treatment for several weeks.
2. Failure to reduce.

The above will give a chance of operative freshening up and reduction.

3. Recurrence after reduction due to too early weight bearing and soft callus giving way; foot assuming the original deformity. If not of long duration—the same treatment as above. If it is of long duration and there is firm union with grossly altered statics of ankle, the problem is different. Thus,

- (a) Ankle-joint mechanics are altered with distortion of alignment of joint and limb as a whole as in supra-malleolar fracture-dislocation, Os-

teotomy (supra-malleolar) is done for correction.

- (b) Where closed reduction or other methods have failed and the joint shows an already established degenerative osteo-arthritis or the articular surface shows too much of distortion, arthrodesis is the method of choice.

#### V. CHILDREN:

Almost always closed method of reduction should be done as early as possible. There is a tendency to early setting in a faulty position. Treatment is done on the same principle as in other simple fracture-dislocations. Immobilisation need not be for more than eight weeks.

*Special complications*—Progressive varus deformity due to premature fusion is a problem by itself and is beyond the scope of the present discussion. Arthrodesis and other open methods are not usually necessary in children.

#### Summary

- (1) Fracture-dislocations of the ankle joint are major disasters and one should be very careful from the onset.
- (2) The strains causing them are of infinite varieties. Less importance should be given to the mode of production. It should be borne in mind that every case is an individual problem and no set rules can be formulated.
- (3) Deformities in a particular case should be assessed from good radiographs; various skiagraphy methods for possible deformities have been discussed. It should be remembered that a particular case may not



fall into one of the standard text book patterns.

(4) From prognosis and treatment points of view, which concern us most, as also the patient, five different groups are recognised.

(5) Complications of Pott-Dupuytren fracture-dislocation should be unknown if above are borne in mind.

(6) Treatment of complications in the adult have been outlined.

I express my sincere thanks to the Principals of the Calcutta Medical and R. G. Kar Medical Colleges, their respective Orthopaedic heads and particularly to Dr. M. L. Barman, F.R.C.S. (E), and B. Chatterjee, M.S. (Cal), who accorded all the facilities to go through their hospital records. My thanks are due to Prof. L. M. Banerji, M.S. (Cal), F.R.C.S. (Eng) and Prof S. K. Basu, M.B., Ph.D. (Edin), for their valuable guidance and encouragement.

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## SYNOVIAL SARCOMAS

by G. D. VELIATH, Madras & K. G. KRISHNASWAMI, Vizagapatam.

### Introduction

The term 'synovioma' was first used by Smith in 1927 to describe the neoplasms that take origin from the synovial membrane in joints, para-articular bursae and in tendon sheaths. To bring into prominence their generally malignant nature, Berger, DeSanto and others suggested the designation 'synovial sarcoma.' They form a special group of mesenchymal tumours characterized by a marked variability of cellular structure rendering histological recognition difficult at times. Their true identity is often missed unless careful microscopic study is undertaken to bring out the specific synovial characteristics and they are liable to be reported and classified as fibrosarcoma or endothelioma. This difficulty of diagnosis may be partially responsible for the comparatively small number of authentic cases reported up to date. An excellent description of these tumours was given by DeSanto, Tennant and Rosahn (1941) whose collection of 16 cases is fully representative of the histological types and patterns in which these neoplasms manifest themselves. Haagensen and Stout (1944) were able to collect 95 cases of synovial sarcoma from the literature to which they added nine additional cases from their own material. A study of 32 cases by Bennett (1947) from the specimens registered at the American Army Institute of Pathology during the war period 1941-45 is the longest individual series we could come across. This paper deals with three cases of synovial sarcoma, two of which were treated in the Stanley Hospital, Madras and the other in the King George Hospital, Vizagapatam. Though the number is small, each case represents a histological type and brings into prominence the marked cellular variations presented by these neoplasms.

\*From the Dept. of Pathology, Stanley Medical College, Madras & the Dept. of Surgery, Andhra Medical College, Vizagapatam.

### Report of Cases

Case No 1. T.R. male 40 years was admitted on 28-10-45 to the King George Hospital, Vizagapatam for a gradually increasing growth around the left shoulder joint of three years duration. Local excision (Dr. K. G. Krishnaswami—24-11-45) revealed a capsulated reddish-brown vascular growth about 4" in diameter, soft and elastic in consistence, and adherent to the capsule of the shoulder joint and the subjacent tissue (Fig. 1).

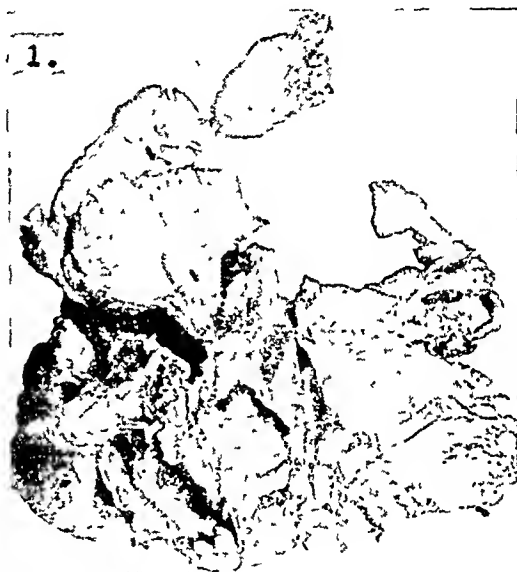


Fig. 1.

Case No. 1. Gross appearance of the growth which was capsulated and about 4" in diameter.

Microscopic examination of sections showed three types of cells — spindle cells, polyhedral cells of varying sizes and large multi-nucleated giant cells (Fig. 2). The latter two varieties were found loaded with reddish brown pigment which on further examination was found to be haemosiderin giving the Prussian blue reaction. A few mitotic figures were found among the spindle cells. Here and there the polyhedral cells showed a tendency to line spaces. Reticulum stain showed the vast majority of cells reticulum positive. Haematoxylin and eosin and Sudan III did not demonstrate any lipid in the sections examined.

Diagnosis: Histiocytic type of synovial sarcoma probably arising from bursae.

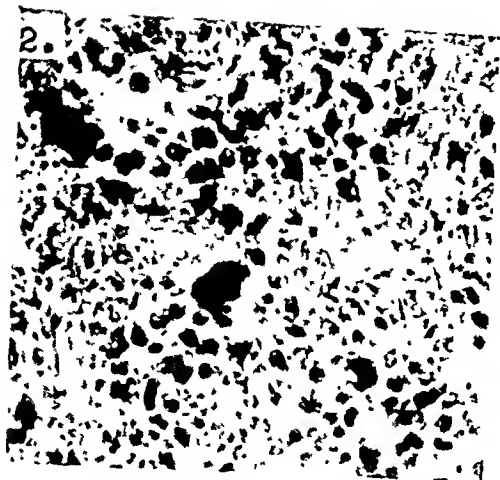


Fig. 2.

Case No. 1. Photomicrograph (H & E  $\times 220$ ) showing the giant cells and polyhedral cells loaded with pigment.

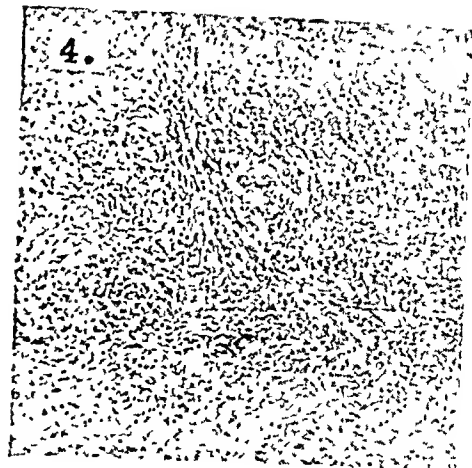


Fig. 4.

Case No. 2. Photomicrograph (H & E  $\times 50$ ). Cellular pattern showing a fibro-sarcomatous appearance.



Fig. 3.

Case No. 2. Section of the knee joint showing intra-articular synovial sarcoma filling the joint cavity and invading the upper end of the tibia.

Patient was discharged cured on 18-12-45. His further progress could not be ascertained.

Case No. 2. R. male, 35 years, was admitted to the Stanley Hospital, Madras, for a gradually growing tumour of the right knee joint of one year's duration. Amputation of the thigh was



Fig. 5.

Case No. 2 Photomicrograph (H & E  $\times 220$ ) showing irregularly spindle shaped cells with many mitotic figures.

done at the site of election (Dr. I. Chelapathi Naidu — 17-11-47). Sagittal section of the joint showed a diffusely homogenous, pinkish white growth filling the joint cavity and the suprapatellar pouch and invading the upper part of the tibia at one area (Fig. 3).

Microscopic examination revealed a general cellular pattern and arrangement suggestive of a fibro-sarcoma with interlacing columns of spindle-shaped cells showing mitotic figures in almost every field (Figs. 4 and 5). Here and there were found irregular gland-like spaces filled with pale staining cuboidal cells (Fig. 6). These with the background of spindle cells presented an 'epitheliosarcomatous' picture (Fig. 7). Reticulum stain differentiated these two cell types



Fig. 6.

Case No. 2. Photomicrograph (H & E x 220) showing irregular glandlike spaces with pale staining cuboidal cells.



Fig. 7.

Case No. 2. Photomicrograph (H & E x 50) showing the "epitheliosarcomatous" picture seen in some areas.

markedly — the spindle cells being reticulum positive and the pale staining cuboidal cells reticulum negative.

Diagnosis: Synovial sarcoma arising from the synovial membrane of the knee joint.

Patient was discharged cured on 29-11-47. He died about six months after discharge. The exact cause of death could not be ascertained.

Case No. 3. G.H. male, 38 years, was admitted on 29-5-48 to the Stanley Hospital, Madras, for a diffuse growth over the posterior aspect of the left shoulder of six months duration and increasing in



Fig. 8.

Case No. 3. Cut section of growth showing the cystic areas inside.

size. Excision (Dr. C. Vyaghreswaralu — 14-6-48) showed a soft circumscribed cystic swelling (Fig. 8) of the size of an orange in close association to the capsule of the shoulder joint and adherent to the muscle bundles around. On section the growth discharged blood stained mucoid material.

Microscopic examination presented a varied appearance — flattened endothelial-like cells lining spaces and infiltrating into muscle tissue (Fig 9); other areas showed a structure similar to that of a papillary adeno-carcinoma — villous processes lined by cuboidal cells (Fig. 10), while various fields showed a pattern of plump spindle shaped cells with round or oval glandular spaces containing mucin giving the histologic picture of an 'adeno-sarcoma' (Fig. 11). Mitotic figures were present but not numerous.

Diagnosis: Endothelial type of synovial sarcoma probably of bursal origin.

Patient was discharged cured on 26-6-48. He returned seven months later with extensive local recurrence; was operated on again on 3-2-49. Patient died the next day.

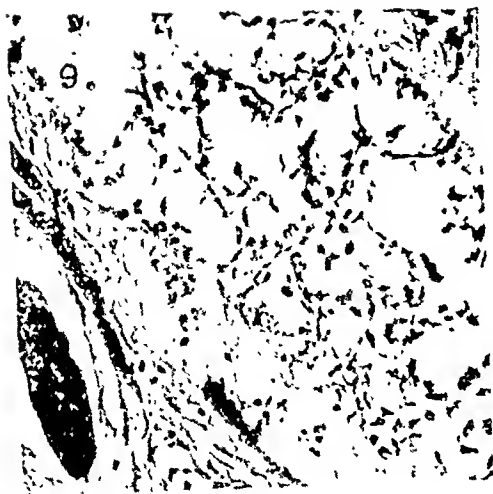


Fig. 9.

Case No. 3. Photomicrograph (H & E x 220) showing flattened endothelial like cells lining spaces.



Fig. 10.

Case No. 3. Photomicrograph (H & E x 220) showing synovial villous processes lined by cuboidal cells.

### Discussion

A full appreciation of the cellular variability of these neoplasms is possible only with an acquaintance with the histologic and functional potentialities of synovial tissue. Berger Vaubel, DeSanto and others have shown that the lining cells of the synovial membrane may at times behave as a mesothelium with a potency towards epithelial and fibroblastic development, or assume the characteristics of reticulo-endothelial tissue with histiocytic properties and



Fig. 11.

Case No. 3. Photomicrograph (H & E x 50) showing the "adeno sarcomatous" picture seen in many areas.

reticulin formation. All these developmental variations are reproduced to a greater or lesser degree by synovial sarcomas. The same tumour may show epithelial or endothelial elements very often lining spaces surrounded by sheets of densely packed spindle shaped or oval cells with abundant supporting reticulum giving the characteristic 'epitheliosarcomatous' picture which is considered a striking feature of most synovial sarcomas (Figs. 7 and 11). This explains why these neoplasms were described as 'fibro-endothelioma' or 'adeno-sarcoma' by various workers. Reticulum stain brings into prominence two distinct cell types, one more or less rounded, pale stained and reticulum negative, and the other generally spindle shaped and reticulum positive.

One characteristic feature of these tumours is their tendency to show a histological development predominantly in one direction. Thus one may come across synovial sarcomas giving a more or less purely histiocytic or fibroblastic or endothelial cell picture. This unilateral morphologic differentiation of cells is well brought out in our cases. In case No. 1, the giant cells and irregular polyhedral cells loaded with blood pigment, with supporting spindle cells, form the main microscopic fea-

ture (Fig. No. 2). Here the histiocytic potency of the synovial lining cells has outgrown and overshadowed the tendency towards endothelial and fibroblastic development which are more or less suppressed. In case No. 2, the cell picture is mainly that of a fibro-sarcoma (Figs. 4 and 5), though here and there, limited to microscopic areas, are seen glandlike spaces showing an endothelial evolution (Fig. 6). No giant cells or mononuclears engulfing blood pigment can be found. Unless a thorough search is made and blocks are taken from different parts of the growth, this tumour is liable to be reported and classified as a fibro-sarcoma. Case No. 3 is essentially an endothelioma of synovial origin where the endothelial characteristics of the synovial tissue exhibit themselves in the formation of flattened cells lining spaces (Fig. 9), and synovial villous processes, (Fig. 10) and the production of mucin.

These tumours differ markedly in gross appearance. They may be diffuse and infiltrative, circumscribed or even encapsulated; firm and homogenous, or soft and almost cystic in consistence. In case No. 2, the growth was diffuse with widespread involvement of the joint and the suprapatellar pouch and even the tibia was invaded. The naked eye appearance of the tumour in case No. 1 was quite different. It was encapsulated, reddish brown in colour and soft and elastic in consistence. Reddish brown colour is characteristic of the histiocytic type of tumours with well-marked haemosiderin pigmentation. Case No. 3 showed a circumscribed growth, very soft and cystic in consistence. The markedly soft tumours are usually of the endothelial type with mucin formation.

All our cases were in men aged 35, 38 and 40. As the number is very small, this observation of the greater incidence of these tumours in the adult male is not of much significance, but it is in agreement with the findings of other workers who have reported much larger series (Berger, DeSanto et al).

Synovial sarcomas are nearly always malignant, but the grade of malignancy varies within wide limits. Case No. 2 arising in the knee joint with wide local extension and involvement of bone and evidence of rapid growth with numerous mitotic figures is illustrative of the most highly malignant form. Case No. 3, circumscribed, with marked endothelial characteristics and mucin formation is a less malignant type. Even in these cases local excision very often results in recurrence sooner or later. Our case returned with extensive local recurrence in seven months time. Case No. 1 capsulated, showing a high degree of histiocytic differentiation with numerous multinucleated giant cells and pigmented mononuclears is the least malignant form.

The *treatment* of synovial sarcomas depends on the grade of malignancy. Diffuse rapidly growing tumours require prompt and early amputation. Encapsulated and circumscribed growths of low grade of malignancy should be treated with widespread local excision followed by intensive irradiation.

### Summary

3 cases of synovial sarcoma are presented, each one showing a more or less unilateral differentiation of cells into a histiocytic, fibroblastic and endothelial type. The general characteristics and cellular variations of these neoplasms are discussed.

### ACKNOWLEDGMENT

The histological study of case No. 1 was first made by the late Prof. T. Bhaskara Menon, who drew our attention to its synovial origin. We pay our respectful homage to his memory. Slides and sections of the growth were lent to us by Dr. G. S. Viswanathan, Prof. of Pathology, Andhra Medical College, Vizagapatam. Cases No. 2 and 3 were from the units of Dr. M. G. Kini, and Dr. K. Chintan Nambiar, Surgeons, Stanley Hospital, Madras. We gratefully acknowledge our indebtedness to these doctors.

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## SURGICAL COMPLICATIONS OF TYPHOID\*

by V. G. VAISHAMPAYAN, Sholapur.

To write a paper on the surgical complications of typhoid fever needs an extensive review of cases treated by one who undertakes such a task. Statistics from infectious fever hospitals having hundreds of beds for treatment of typhoid fever, exist only on the continents of Europe and America. The Bombay Fever Hospital has no special accommodation for typhoid cases. We have no local hospital in Sholapur from which any compilation could be made of the complications in typhoid fever cases.

There are advantages as well as disadvantages from the point of a surgeon like myself, situated in a locality where accommodation for these patients in hospitals is meagre, if none at all and thus most of these complications come to a surgeon like myself for their treatment. In order to make my paper complete I have referred to cases of such complications from surgical literature which I have studied to guide me in my treatment of such cases.

The relative scarcity of articles in medical literature on the treatment of complications in typhoid fever would lead one to believe that such complications are either of no significance or that the technique of such cases had become so well perfected that nothing remained to be said further about it. However, one accustomed to come in contact with such cases in a city like Sholapur where typhoid is fairly rampant is constantly presented with evidence that this is not the case.

Surgical complications are not only due to the activity of typhoid bacilli, and their toxins but also to other organisms which flourish on account of the lowered resistance of such patients and the vaso-motor

disturbances in the peripheral regions where circulation is poor.

The following is a list of the different surgical complications of typhoid fever :—

1. Perforation.
2. Haemorrhage.
3. Tropic Conditions.
4. Typhoid Spine.
5. Osteoperiostitis.
6. Oto-typhoid.
7. Urinary complications.
8. Hepato-cholangitis.
9. Mastitis.
10. Phlebothrombosis and phlebitis.
11. Empyema.
12. Genital complications.
13. Suppurative splenitis.

I will take first and deal with *perforation* of the ileum in enteric fever. It has been well said by Dr. Dunkerley in his paper on this subject that few diagnostic problems are more urgent and more difficult to solve than those encountered in perforated typhoid ulcers of the intestine. His observations were based on a clinical experience of 1,017 typhoid cases in Kolar Goldfield Hospital. My experience about this complication differs from accounts in text books of this complication in the same way as his. His experience is of ten years during which he met twenty two cases of perforation among 1,017 typhoid cases. Mine is from an experience of 15 years when I met 16 cases among the 344 I treated. In his cases perforation rate is 2% of all the typhoid cases and 30% of such cases have died according to his record. In my cases perforation rate is about 5% of all the typhoid cases and 60% of such cases have died according to my record. The high rate of mortality in all my cases was due to the patients having come to the Hospital late for treatment.

\*A paper read at the X Annual Conference of the Association of Surgeons of India, Dec. '48.



Perforation is common in cases with profuse diarrhoea, meteorism or haemorrhage from bowels and occurs at any time after the second week. Such patients are full of toxæmia and are moribund. There is sudden collapse with fall in temperature and rise in pulse but not always so. A deceptive improvement may occur. Sometimes the onset is so insidious that the diagnosis is not made until general peritonitis has set in with rapid death. If the loop is in the pelvis frequent painful micturition, rectal tenesmus and tenderness on digital examination are to be noticed. Pain in the abdomen is severe, persistent and early rigidity with distension and loss of liver dullness are present. Polymorphonuclear leucocytosis after perforation is found if examination is made early, but not later. Ten per cent of cases may have more than one perforation. The perforation lie within ten inches of the caecum. The mortality varies from 75% to 95%.

Perforation has also occurred in my cases on the third, fifth, eighth, eleventh and fifteenth day of fever. Diarrhoea was the common factor but neither haemorrhage nor meteorism was noticed. Pain was constant in the lower abdomen or in the vicinity of the umbilicus. Irritation of pelvic viscera giving rise to tenesmus and frequency of micturition and vomiting were not reliable as symptoms. Rigor after perforation was common and may be enquired into. Temperature ranged from 102° to 103°; may become sub-normal. Pulse rose from 88 to 130; Widal's test was positive in the majority of cases but was not infallible.

Dunkerley operated within twelve hours in six cases and recovery was obtained in four. Two out of three operated on between 12 and 24 hours recovered and one out of two recovered after 36 hours. As regards the cases that I operated on the interval after the perforation varied from three hours to four days. None of my cases survived. Perforation was repaired with interrupted sutures through all coats and buried by seromuscular stitches and omentum stitched over. Wound-infection was a

troublesome sequel. Period of survival before death was from two hours to twenty four hours in my cases. Sulphonamide powder was not used. Drainage was not resorted to. Post-mortems were not permitted.

**CONCLUSIONS :** Modern methods of resuscitation such as plasma and blood transfusions, hydrolysed casein and aminogen were not tried in my cases. I attribute my high death rate due to omission of many of these recent resuscitation methods. I should like confirmation from some of you who may have been more successful in the treatment of perforation cases than myself. I should like to know also about the advisability of solid diet consisting of ordinary digestible food which becomes reduced to the physical character of liquid diet by the time it reaches the last portion of ileum where perforation takes place in contrast to liquid diet of less calorific value which diminishes the resisting power of typhoid cases for recovery from such surgical complications. Typhoid perforations have often healed spontaneously according to reports in the medical press. Perforation occurred in a woman aged 27 who died of broncho-pneumonia seven days after presenting symptoms of peritonitis. The rapid disappearance of signs of peritonitis suggested a wrong diagnosis. But autopsy revealed a perforation in the ileum in the process of cicatrization. Hartman in 1908 has described in a similar case. A case was brought to my attention by Dr. Gadgil where Dr. M. G. Talwalkar operated on a case which was treated by large doses of penicillin; the patient developed a fluid swelling in the hypogastric and lumbar regions which contained nothing but serous fluid, which was aspirated and thus the patient recovered.

*Haemorrhage* in typhoid cases is not common though it is a severe complication when it occurs. The symptoms to which I pay attention are rapid pulse rate, sub-normal temperature and collapse. I have had 33 cases in which haemorrhage was treated with haemostatic drugs. Transfusion of blood was resorted to for its action not

only for resuscitation as regards the fall of blood pressure but also for its anti-toxic action. Prof. Bourgers maintains that the best results are obtained from the blood of a donor who has had an attack of moderately severe typhoid a few months previously. The value of the transfusion is often shown after severe haemorrhage when other methods have failed and also in relapsing and protracted forms of the disease to control toxicity. I fear, I am unable to give you a definite opinion about this method having not tried it myself. I have tried vit. "K" but cannot definitely say that this has any great value in the treatment of haemorrhage.

*Trophic Conditions after Typhoid Fever :* Bed sores are fairly common after typhoid. A great care in nursing is necessary to prevent this complication. Once developed, these sores, I have found very difficult to cure.

*Typhoid Spine :* Murphy in 1916 analysed 530 cases of typhoid lesions of bones and he found 110 cases where the spine was involved. In one case an abscess was formed which burst in the spinal canal giving rise to myelitis and in another, the abscess burst into a bronchus giving rise to broncho-pneumonia. The spine is generally said to be affected in males; the lumbar vertebrae being affected in the majority of cases the dorsal come next and rarely the cervical or sacrolumbar regions. Typhoid spines may occur late in convalescence or after a patient has resumed work, and either spontaneously or after a minor accident. There may be a (i) diffuse periostitis or (ii) a local focus showing early destruction of intervertebral disc or (iii) osteomyelitis or (iv) extensive affection of several vertebrae. The prognosis is very favourable in these cases. Complete recovery takes place in a few months after immobilisation. Typhoid spondylitis occurs in adults, but children are not immune. It most frequently occurs at the onset of convalescence. The principal symptoms are sudden and severe lumbar pain most marked at night. Sensory and sphincter symptoms are absent. There is

disappearance of the intervertebral disc, and production of osteophytes. It is to be diagnosed from Pott's disease, sciatica, staphylococcal osteomyelitis. Widal's reaction and history help diagnosis. It never ends in suppuration though it may last from 2 to 6 months. The prognosis is good as regards life. Treatment consists of rest in the horizontal position and the administration of typhoid and para-typhoid vaccines.

*Osteoperiostitis,* after typhoid fever is said to be rare; only four cases out of 1,000 patients are reported to have had this complication. Its incidence is more frequent in young persons below 25 and is lowest after 35. It is due to persistence in the bone marrow of typhoid bacilli which give rise to circumscribed lesions and behave like pyogenic organisms. This complication may appear at an early stage or late stage of fever but in the great majority of cases it develop six or eight weeks after its onset and some times not till several years later. B. typhosus and para-typhosus are to be found in the lesions and the blood. Sometimes instead of B. typhosus and allied groups, streptococcus, staphylococcus and pneumococcus are found and the prognosis then is grave. Typhoid cases generally recover. In non-suppurative cases typhoid vaccine has been found to be very useful. Penicillin in such cases has been very valuable in my hands.

*Oto-typhoid :* Professor Peroni in Archives of Utology mentions a fatal case of oto-typhoid in a man of 20. There was chronic inflammation of the middle ear, complicated by meningitis and abscess of the inferior temporal lobe, and convulsions with dilated lateral ventricles. The cerebro-spinal fluid was turbid and showed typhoid bacilli. Widal was positive 1 in 250. No lesions were found in the intestines at the post-mortem. This case was a primary infection of the middle ear by typhoid bacilli.

*Typhoid in Urinary system :* In cases suffering from typhoid fever one may meet B. coli pyelonephritis taking the ordinary

acute form with rise of temperature, lumbar pain and pyuria. They generally end favourably. Reimann in the J.A.M.A. records a case illustrating typhoid infection of the kidney. The attack may occur during fever, in convalescence or many years afterwards. In some cases it is difficult to get a history of any previous intestinal trouble. This case occurred in a man of 70 who had a typhoid bacilluria, threatened uraemia, pyuria, haematuria, and pain in the right lumbar region and fever of 47 days duration with no intestinal symptoms. Typhoid bacilli disappeared from urine after the administration of mandelic acid. Millar and Wolfirth report two cases with gangrene and exfoliation of the bladder in typhoid, and state that the complication is rare. Only 8 cases were reported when they wrote their paper in 1924. The cases occurred in women and most of them had been catheterised affording opportunities for direct introduction of these organism through the urethra; all but one case were fatal.

*Hepato-cholangitis and typhoid abscess:* B. Vincent in the J.A.M.A. (1932) reports a case of hepato-cholangitis. This patient was a typhoid carrier for 26 years. He had several monthly attacks of pain in the upper quadrant of the abdomen and recurrent jaundice. Cholecystectomy was performed but abdominal pain persisted. An abscess in the right rectus containing pus with B. typhosus was evacuated leading to complete recovery. Rupture of the rectus abdominis due to degeneration and resulting haematoma or abscess, is one of the complications to be borne in mind by surgeons. Rost from Scandinavia records two cases of rupture of the recti muscles due to Zenker's degeneration. The symptoms closely simulated intestinal perforation owing to the sudden attack of abdominal pain. Laparotomy was performed in one case, a haematoma was discovered in the second case which was diagnosed properly.

*Non-suppurative mastitis:* In Bulletin-Academy de Medicine, Sabraze records an example of this uncommon complication of

typhoid fever. This condition is rarer than suppurative mastitis. It is frequent at the age period 20 to 40. It develops as the typhoid temperature falls and may be bilateral. It subsides in two or three weeks. H. D. Wicker mentions a case of typhoid ten years after cholecystostomy. Two months after this, she developed symptoms of obstruction in the common duct with jaundice. Duodenal drainage showed typhoid bacilli. Laparotomy was performed and two stones removed. A month after her discharge she developed a breast abscess from which a culture of B. typhosus was recovered. Patient recovered completely six weeks after discharge.

*Thrombosis of Veins:* Etienne in Medical Annual of 1922 speaks of phlebitis in a woman aged 34 who on the 30th day of typhoid developed phlebitis first on the left and then on the right lower limb. There was extensive oedema not only of the limbs but also of the lumbar and abdominal regions. Blood culture showed typhoid bacilli. Phlebitis is rare in children. A case of thrombosis of the inferior vena cava has been known giving rise to enlargement, dilatation and varicosity of the superficial veins of the lower extremity and abdomen.

Prof. Bankheira of Mont Pier University writes of the complications of typhoid in a pregnant woman. It may cause the death of the embryo in the early months and be followed by abortion. Or, it may, in later months, give rise to premature delivery of a living child.

*Suppuration in the ovaries* after an attack of typhoid is recorded. B. typhosus, being a pyogenic organism, no other organism in association with it is needed. The suppuration may be acute, sub-acute or chronic. Several years may lapse after an attack of typhoid. *Diagnosis* is difficult but the treatment is wholly surgical.

*Pneumococcal Empyema* has been known as a complication of typhoid fever; this generally ends favourably if due to pneumococi, but empyema, caused by B. typhosus do not give rise to such a favourable result.

M. Brule describes a case of gangrenous vulvitis in a virgin occurring at the onset of typhoid. Severe constitutional disturbance suggested gangrene due to other causes till blood examination showed typhoid bacilli.

Greenburg reports cases of *epididymitis* after typhoid, 102 in number. In 31 the testes were affected; in 10 the epididymes were affected and in 43 testes, epididymes and cord were involved. Suppuration oc-

curred in 22 and in many cases atrophy of testes took place. B. typhosus were recovered in many cases.

I have not come across cases of suppurative splenitis or suppurative hepatitis. I shall be very glad to hear from some of you about the frequency of these complications and the prognosis of such cases.

I am indebted to Dr. S. Gadgil F.R.C.S. for advice in the preparation of this paper.

# SURGICAL COMPLICATIONS OF TYPHOID\*

by A. V. BALIGA, Bombay.

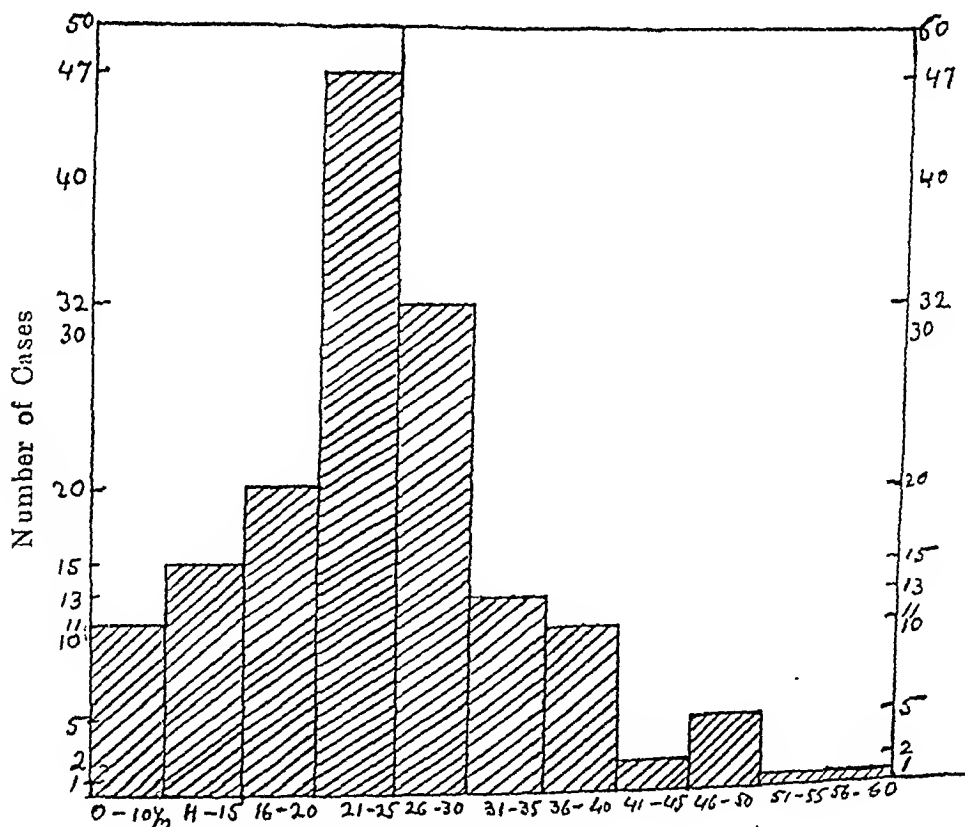
In seconding the paper on the surgical complications of typhoid, my observations will be confined to intestinal perforation and acute cholecystitis — the former a common but serious event and the latter, an equally serious but interesting though uncommon condition occurring in the course of typhoid or during convalescence. In the study of the subject of typhoid perforation, the available literature, in journals and books is poor and disappointing.

All cases of typhoid admitted to K.E.M. Hospital and Arthur Road Hospital for Infectious Diseases at Bombay during the period 1940 to 1948 were collected. In a total of 6,818 cases from these two hospitals,

\*A paper read at the X Annual Conference of the Association of Surgeons of India, Dec. '48.

the common surgical complications were as given below :—

1. Perforations	158 — i.e. 2.4%
2. Parotitis	139 — (11 abscesses.)
3. Bedsores	81 — (1 Bone necrosis.)
4. Ear discharge	35
5. Associated pregnancy	30 — (In 15 there were abortions, with 1 death during labour.)
6. Hepatitis	29
7. Arthritis	22
8. Osteomyelitis	10
9. Venous thrombosis	10
10. Cholecystitis	9
11. Typhoid spine	6
12. Mastitis	3 — (1 Mammary abscess.)
13. Empyema	3
14. Gangrene of finger	1



Age in Years

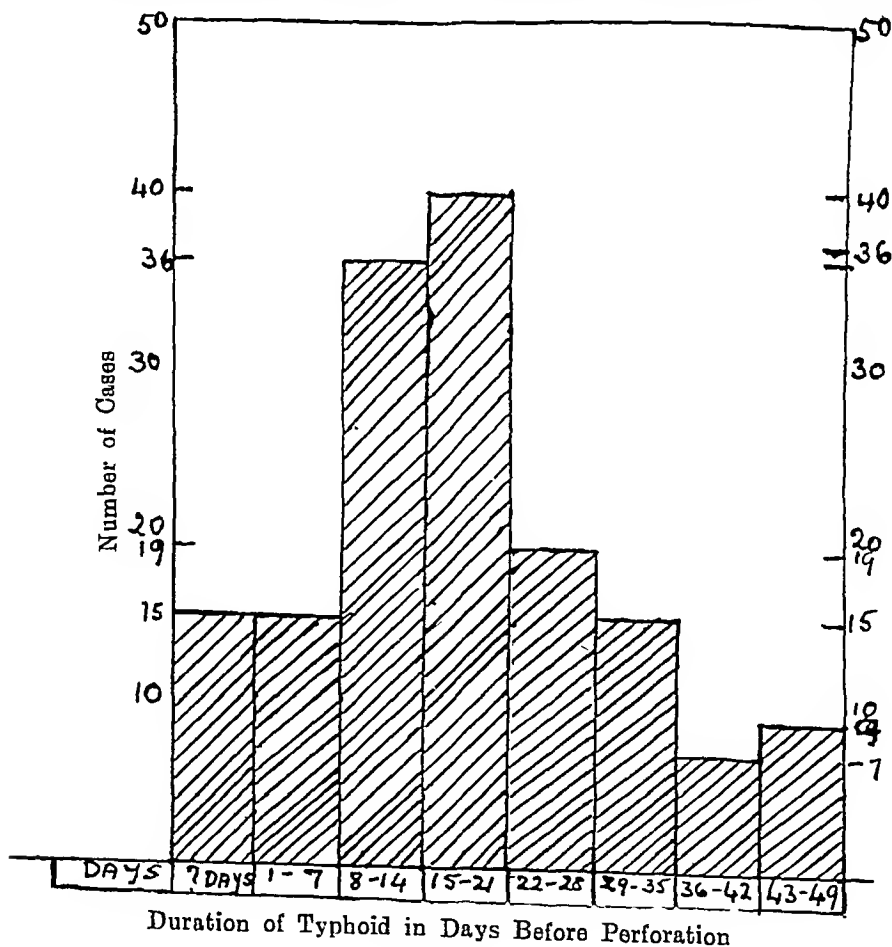
GRAPH 1

**Perforations:** From this table it is evident that perforation tops the list of surgical complications. Of the 6,818 cases of typhoid, 5,230 were from the Arthur Road Hospital and 1,588 from the K.E.M. Hospital. All the cases of perforation at the Arthur Road Hospital were transferred to K.E.M. Hospital for surgical treatment.

In most of the standard text books the incidence of perforation is given as 4 to 5%. In Dunkerley's series of 22 consecutive cases, it works out at 1% in the non-ambulant cases and 2% if the ambulant patients are also included. In this series of 6,818 typhoid cases, intestinal perforation occurred in 158 i.e. in 2.4%. Dunkerley explains the low incidence of typhoid perfo-

ration in his series in Mysore as possibly due to lower virulence of infection in typhoid in South India. Our figures in Bombay tally with his but I cannot say, that, the virulence of the infection in Bombay is any lower than elsewhere. One fact to be noted is, that typhoid fevers have a varying virulence and mortality in the different epidemics from year to year and sometimes even during any given year.

Age incidence so far as perforation is concerned is illustrated by Graph 1. Fully forty seven cases occurred in the age group between 21 and 25, and thirty two cases in those between 26 and 30. Thus, in the third decade alone, one sees 79 Perforations out of 158, an exact 50% of the total cases.



GRAPH 2

The youngest patient was one month old and the oldest 60 years — both of these died. In Dunkerley's small series the average is given as 18 years. In this study, though the actual average has not been worked out a look at the age groups convinces one that perforation occurs at a later age, near the age of 25.

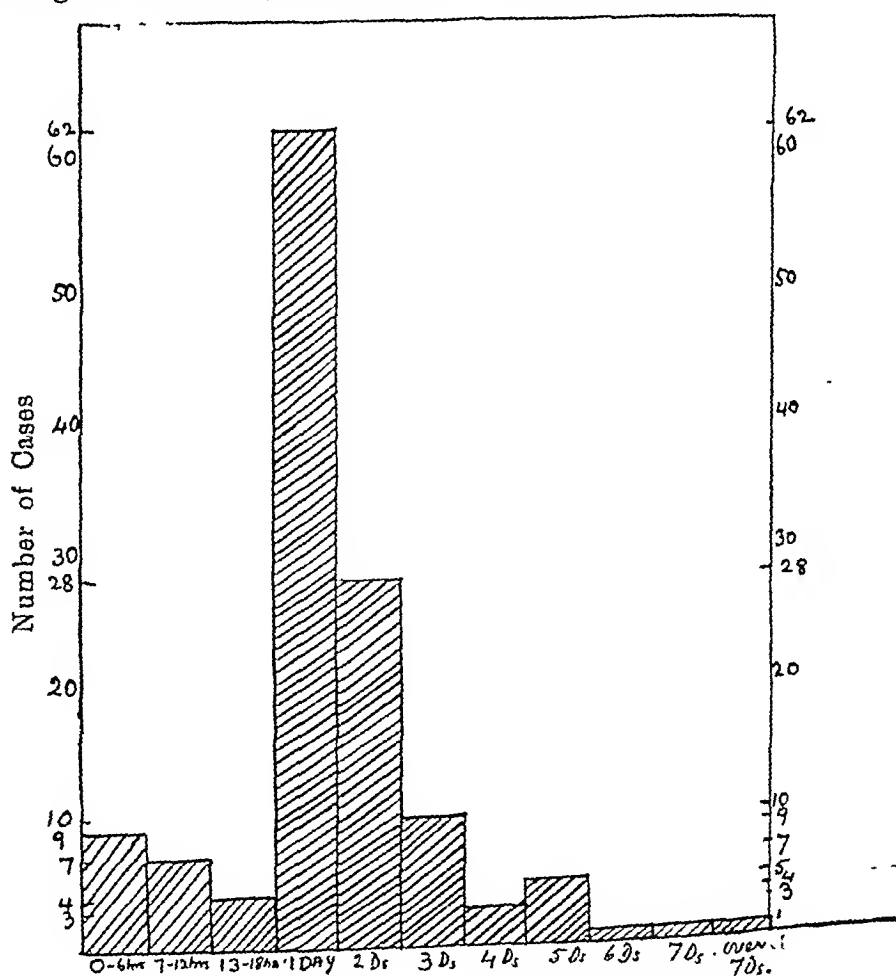
In Dunkerley's 22 cases all were males. In our group of 158, 123 were males and 35 females.

The information regarding the duration of typhoid before perforation occurred, is brought out clearly in Graph 2. 40 occurred in the second week and 36 in the third week making a total of 76 out of 158 in the second and third weeks — that means a little less than half the cases. This agrees with our usual impression and text book description. According to Dunkerley's collection,

the average course of typhoid before perforation was 11 days in the non-ambulant group and 4 days in the ambulant. It is a distinctly much earlier period than in this series. In my series I have not calculated the average day nor is the division made into ambulant and non-ambulant.

The duration of symptoms of perforation before admission is a most important factor that bears on prognosis and treatment. In this series (Graph 3) out of 158 cases, duration of symptoms was recorded in only 132. Perforation was of 1 day's duration in 62 cases (46.9%) and 2 days in 28 cases (21.2%). Only 9 instances are present of patients' admission within 6 hours of the catastrophe (6.8%).

**CLINICAL PICTURE:**—Abdominal pain appearing in the course of typhoid fever must always be observed with suspicion. Any



Duration of Symptoms Before Admission  
GRAPH 3

sudden pain of a severe kind in a patient who hitherto was quiet must at once be considered to be a probable perforation. In a certain number, dull pain and abdominal discomfort are present for several days and in these cases, pain would not be a helpful symptom unless it is severe, very different from the old dull ache and there are some other symptoms and signs of the condition. Pain is generalised all over the abdomen in the vast number but in some of the cases it is localised to the lower abdomen or is present in the right iliac fossa only. Pain during the act of micturition or retention of urine also may be the first symptoms of a perforation.

Tenderness is generally present but not so well marked as in other types of peritonitis, and rigidity is sometimes unconvincing. In a large number of cases there is only a well marked resistance to a good examination. Pain, tenderness and rigidity may be very inconspicuous in a patient who is very toxic and in a "typhoid" state.

Distension is present as a rule, and sometimes, cannot be distinguished from the distension present in typhoid before the bursting of the intestine.

Liver dullness is obliterated in about half the cases and if a radiogram of the abdomen is taken in a steeply inclined head high position, one gets the presence of gas under the diaphragm. Generally speaking no surgeon needs the radiological demonstration of the presence of gas under the diaphragm for establishing the diagnosis but in a small number of cases, when all other symptoms and signs are indefinite and inconclusive in a seriously ill patient, and clinching the diagnosis is of the highest importance, this ancillary method may prove helpful.

Presence of free fluid was noted in 70 out of 158 cases, a physical sign that most people either do not look for, or, give little importance to.

Absence of peristaltic sounds on auscultation indicates paralytic ileus. It was recorded in 95 out of 158 patients,

Rectal examination should never be omitted. Pain, tenderness and sometimes fullness are present. Positive rectal findings were available in 61 out of 159 patients.

The pulse rate gets markedly accelerated, particularly, in the later stages, with the onset of paralytic ileus and the pulse volume goes down rapidly.

Respiratory rate often jumps up with the perforation—a feature I would like to emphasize here. The accelerated respiratory rate is there in the absence of pulmonary complications and even before any distension of the paralytic ileus sets in.

The triple Widal reaction was done in 64 cases. It was positive to *B. typhosus* in 50 and to *B. paratyphosus* in 6 but it was negative in 8 of the cases.

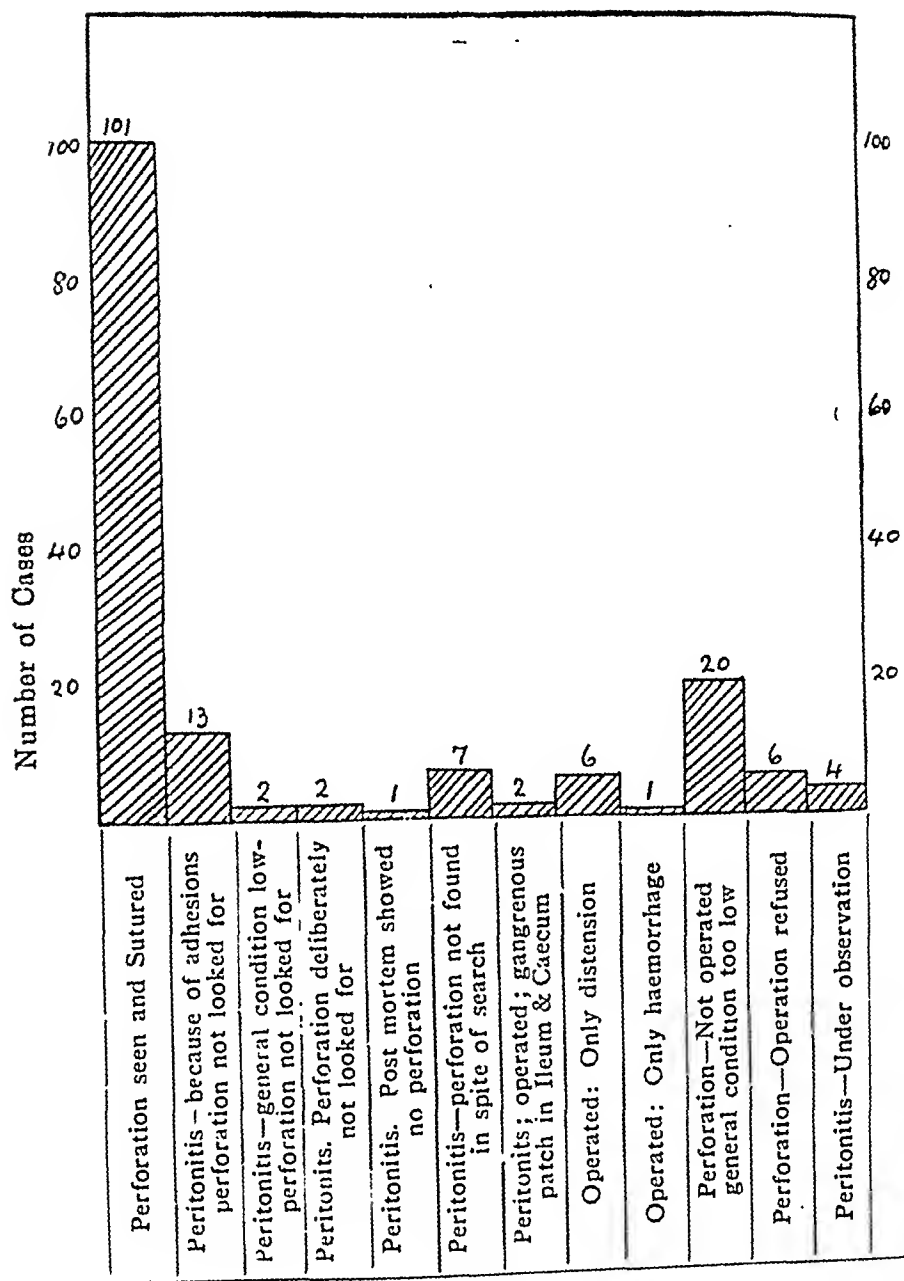
White blood cell counts were carried out in 44 instances and in only 18 was it above 10,000. In a large number the total leucocytic count was nearly normal. There was however a preponderance of the polymorpho-nuclears.

Blood culture was positive in 4 cases.

The findings on the operation table are illustrated in Graph 4 with details of operative treatment.

In 101 cases there was perforation and it was sutured. In 13 there was peritonitis but the perforation was not looked for because of adhesions. In 2 patients there was peritonitis but the general condition of the patients was too low and hence the perforation was not looked for. In another 2 there was peritonitis but the perforation was not looked for deliberately and one of these cases lived. In one there was peritonitis and a post-mortem examination failed to reveal any perforation. In 7 there was peritonitis but in spite of careful search there was no perforation seen. In 2 there was a gangrenous patch, one in the ileum and the other in the caecum—both these cases died; in one of these an ileostomy was done. In 6 there was only distension and in one there was haemorrhage in the





Findings In Operated Cases  
GRAPH 4

intestinal lumen at laparotomy. In 20 cases of perforation diagnosed clinically, no operation was performed because their general condition was too low. Operation was refused in 6 cases of perforation, and in 4 cases of the series, the patients were only observed. In fully 25 operated cases there was peritonitis—but perforation was either not looked for, or, could not be found. I am

making this observation because there are examples in literature of peritonitis without perforation—probably the infection travels directly to the serous cavity without a breach in the intestinal wall or one of the mesenteric lymph glands is responsible for the peritoneal infection.

Fluid present in the peritoneal cavity was serous or seropurulent in 45 and frank pus

in 55. Faecal material was noted in 16 cases and a round worm in one. Flakes of lymph were observed in 43 cases and in 12 there was plastic peritonitis. Location of perforation, where noted, was mostly in the terminal ileum, one was in the caecum and another in the jejunum. In one there was perforation of a Meckel's diverticulum and in this case there were noted 3 ileal perforations also. In one instance after suture of a perforation, a fresh perforation occurred after 4 days and the patient succumbed after the second operation.

In only 9 was the fluid bacteriologically examined; 1 by smear showed *B. coli* and in the other 8, the fluid was cultured and yielded *B. coli* in 6 and *B. coli* and streptococci in 1 and *B. pyocyaneus* in 1.

Anaesthesia employed was local in 63, general in 54, and spinal in 46. Recently local anaesthesia was combined with sodium pentothal given along with intravenous saline infusion. Large numbers were done under local partly because some of the patients were too low for any other anaesthesia, and in the majority local anaesthesia was safe besides being sufficient.

Laparotomy was done by the right lower paramedian approach in 80 and the median in 25. In others there was no mention of the incision used. Simple suturing of the perforation was done in 83 and suturing and omental graft in 20. Mere drainage of the peritoneal cavity was carried out in 2 and ileostomy in 1. There were comparatively more survivals in the group where omental graft was used in addition to suturing of perforation. Suprapubic drainage was employed in 45 and the parieties also drained in 22 patients.

Post-operative deaths were highest in the first 24 hours — 42 out of 141 — and 21 died in the succeeding 24 hours. Thus as many as 63 deaths were in the first 48 hours, evidently because of severe toxæmia accompanying typhoid and peritonitis. Anaesthesia and operative shock may be partly responsible for some of the early deaths

within 24 hours. 19 patients survived the operation but died 1 to 3 weeks later, due to some complications associated with the underlying disease such as relapse, toxæmia and haemorrhage.

17 patients survived the operation from among 158 admitted as typhoid perforation, giving a survival figure of 10.7%. If those not operated on be excluded, then 128 were operated on with 17 survivals, working out at 13.2% survival rate. A good number of the operation wounds got infected and one had a complete burst abdomen and another partial burst abdomen. In 5 the wound edges were gaping. The duration of stay in hospital after operation of the survival cases was quite long — 30 to 40 days being the usual. The reason for this was obvious — the patient had to go through the course of enteric and further complications like wound infection delayed healing.

Analysing the 17 survivals, I find that before 1943 not one patient lived after operative treatment. In 1948 we had 8 successes in the course of 11 months. The advent of chemotherapeutic drugs like sulphonamides and antibiotics like penicillin was responsible for the improved outlook for surgical treatment between 1943 and 1946, besides the free use of resuscitating measures like saline, plasma and blood. During the years 1947 and 1948, the more frequent employment of protein hydrolysate and the availability of streptomycin in addition to the measures already mentioned, must have been responsible for a greater number of survivals.

Analysing my personal cases, I had occasion to treat 9 cases of perforation, of which 1 was at K.E.M. Hospital and the remaining 8 in private practice.

Analysing the 5 fatal cases :—

1st was a lad of 20 who was operated on 14 hours after perforation but died 48 hours later as a result of a very large malaena.

2nd was a boy of 10 who was operated on 12 hours after perforation but died within 24 hours. This patient was very toxic and

the general condition was very poor before operation.

3rd was a boy of 9 who was operated on 6 days after perforation for a localised mass in the right iliac fossa and partly in the hypogastrium. This patient died 48 hours later.

4th was a boy of 10 who got a perforation, was too low to be operated on and hence left alone. 6 days later he had to be operated upon for acute intestinal obstruction from a band adherent to the terminal ileum, evidently from the perforation 6 days previously. 3 days later, again he developed obstruction with visible coils and colicky pains and he was opened up again. 6 days later when his abdomen had nearly settled down, he suddenly developed heart block and died.

5th was an adult, a medical man, who had apparently no preceding pyrexia and the clinical diagnosis was acute appendix with perforation and peritonitis. Operation was performed some 14 hours after commencement of acute pain and there was general peritonitis with abundant thin brownish fluid and practically no adhesions. Appendectomy was done and the pelvis, right iliac fossa and abdominal wound drained. From the next day the temperature went on steadily rising, the patient, got into a regular "typhoid state" and died on the 6th post-operative day. His chest was clear clinically and radiographically, the bowels moved well so far as flatus was concerned from within 24 hours of the operation and the section of the appendix was reported on as showing the pathology of typhoid inflammation.

Of the personal series of 9 operated cases, 4 survived; the first was an adult, cook of a friend of mine. There was history of pyrexia of only 4 days' duration and his abdominal pain was diagnosed as due to appendicular inflammation by the attending physician. He was admitted to K.E.M. Hospital and operated upon as an acute abdomen with general peritonitis of 14 hours duration—possibly a typhoid perfora-

tion. It was a typhoid perforation alright and he did very well so far as the surgical condition was concerned. But he got a relapse of his fever which was diagnosed by laboratory test as paratyphoid for which he was transferred to the medical side since his laparotomy wound had healed. He went home completely well 4 weeks later.

The second survival in my series was a film actor who perforated in the third week of typhoid and was operated upon 8 hours after the catastrophe. He had a stormy convalescence but got over it all in 3 weeks.

The third successful patient was an adult Parsi lady in whom laparotomy was done 18 hours after a perforation. In her penicillin and streptomycin were used parenterally and intraperitoneally at the time of the operation. She did exceptionally well — the convalescence being as smooth as that of a clean abdominal operation.

The fourth of the personal series that did well was that of an adult business-man who was operated upon in the 4th week of typhoid, 18 hours after a small perforation. He made an excellent recovery.

There is a great difference in the survival figures at the general hospital and in private practice — 13.2% in K.E.M. Hospital as against 44.4% in private. The reasons are: the general condition of the patient seen in private is very much better, the diagnosis of a perforation is comparatively early and further, the operation is done much earlier after such a diagnosis. Other factors are the experience and skill of the operating surgeon which is certainly better than that of a comparatively junior surgical officer at the Hospital and the availability of all resuscitative measures and antibiotics in private as compared with the facilities in a charitable Hospital.

**Typhoid Abscess of the Spleen:** Ransohoff in 1940 reported a case of a huge enlarged spleen with a positive Widal — but no significance was attached to the Widal test. His severe anaemia was treated with

repeated transfusions and a splenectomy contemplated. On laparotomy a huge spleen adherent to the anterior abdominal wall and containing an abscess cavity, was seen. The abscess was drained through a stab incision. Pus gave a pure culture of typhoid bacillus. Temperature persisted and after a month he was taken up again and splenectomy carried out. The patient did very well. This is a most rare complication but extremely interesting.

**Acute Typhoid Cholecystitis:** Rubeinstein of Boston has given an interesting review of 4 cases of acute typhoid cholecystitis seen and treated by him.

Chiari in 1894 recovered this organism from the gall bladder in 19 out of 22 cases going to the autopsy room. Nevertheless, clinical evidence of invasion of the gall bladder is comparatively infrequent.

Holscher observed gross changes in the gall bladder in 5 out of 2,000 post-mortems performed in typhoid deaths. Keen (1898) recorded 30 cases of typhoid cholecystitis. In 1907 Thomas collected 154 cases of typhoid complicated by acute cholecystitis — in 39 of these, i.e., about 25%, perforation of the gall bladder occurred. In 1908 Ashhurst reported 21 operated cases of such typhoid cholecystitis. Most of the reported instances have been in children.

In 1920 Reid made the observation that pain and tenderness in the right upper quadrant of the abdomen associated with slight muscle spasm may often be encountered during the course of typhoid. In the majority, these symptoms subside. When however the damage to the gall bladder is more extensive, gall bladder is definitely distended and operation becomes necessary.

In the majority, signs of cholecystitis are noted after the 2nd week of the fever — exceptionally at the very onset of it.

Perforation of the gall bladder is a serious end result of acute typhoid cholecystitis. Liege and Foliasson reviewed 35 published reports of cases in children, in which, perforation occurred in 16, i.e. 46%. Further,

perforation occurs within a few hours of the commencement of the signs of gall bladder involvement. Failure to operate results in 100% mortality. Surgical interference must be early and prompt.

Jaundice in typhoid is rare. It may be associated with gall bladder involvement or with hepatitis.

In the 4 cases of Rubeinstein :—

Case 1 had acute cholecystitis, the widal was positive and the attack subsided without operation.

In case 2 cholecystectomy was done and widal was positive after the operation.

Case 3 had a high count, severe pain and distended gall bladder. The gall bladder was drained — but stools continued to show typhoid bacilli till 9 months later when cholecystectomy was performed ending the carrier state.

In case 4 widal was positive and cholecystostomy was performed for a tense, distended and inflamed gall bladder and the bile showed a pure culture of typhoid bacillus. He remained a carrier in bile and stools till 11 months later when cholecystectomy was done and at that time the bile still gave a culture of typhoid bacillus.

In cases 2 and 3 association of typhoid was established after operation. Attendants on patients 2 and 4 came down with typhoid. This clearly points to the risk in undiagnosed typhoid. When the picture of acute gall bladder is clear, the underlying typhoid may be overlooked. Hospital personnel may contract typhoid subsequent to contact with undiscovered typhoid carriers admitted to hospitals for operation on the gall bladder.

Thus in acute as well as chronic cholecystitis, — and chronic cholecystitis is a well established entity due to typhoid bacillus with carrier state — *Bacillus typhosus* as the possible causative agent must be actively remembered.

Patients 3 and 4 were carriers but were cured by cholecystectomy. Case 2 would probably have become a carrier if the gall bladder was not removed. Case 1 had stools positive for some months.

A diagnosis of typhoid must be considered in any case of acute cholecystitis in which preceeding the onset of gall bladder symptoms, there is a period of unexplained pyrexia without any other localising sign.

In a series of cases of chronic cholecystitis reported by Bigelow and Anderson in 1933, gall stones were found in all. No stones however are reported in those operated on for acute cholecystitis.

To protect hospital personnel, think of the possibility of typhoid when treating cases of acute as well as chronic cholecystitis, all laboratory studies must be carried out, careful handling of discharges and dressings by the attendants insisted upon, and immunisation of the same persons routinely done.

Coller and Crabtree have interesting observations on biliary typhoid carriers. Typhoid carriers are urinary, intestinal and biliary — the last the most important.

This carrier state is cured in about 90% of cases by cholecystectomy — general health of the patient being good. Botsford reported a case in which *B. typhosus* was cultured from the centre of a gall stone 2 cm. in diameter removed 43 years after the original attack of typhoid. McGuire reported a case of no cure of carrier state by cholecystectomy but later removed a calculus from the common bile duct and performed choledochostomy — thus curing the condition.

In this personal series there are two cases of acute cholecystitis:

No. 1 was diagnosed as acute abdomen on the 18th day of typhoid and he had well marked jaundice, which made me think of an acute gall bladder infection or possibly a burst liver abscess. On laparotomy, there

was bile in plenty in the peritoneal cavity and a perforation was seen at the fundus of the gall bladder. Cholecystectomy was done with drainage of the peritoneal cavity. This patient died 36 hours later.

Case No. 2 was a girl of 8 daughter of a friend of mine whom I saw on the 59th day of typhoid for acute pain, nausea and pyrexia. There was a tense, exquisitely tender, and big gall bladder palpable. Empyema of the gall bladder was diagnosed and the child asked to be transferred to my clinic. On the way to the clinic, the gall bladder perforated resulting in accelerated pulse rate, general abdominal pain and vomiting. Within an hour a laparotomy was done and a gangrenous patch 1½ cm. by 1 cm. was noted near the fundus with local peritonitis, and with an attempt at localisation by omental and other adhesions. The gangrenous patch was excised and cholecystostomy carried out with a drainage of the Morris's pouch.

After giving an anxious time for 5 days, this girl recovered and is now a picture of health. Whether she was a carrier after the operation for any length of time was not investigated.

The quick course of typhoid cholecystitis going on to perforation and its more common occurrence in childhood are well illustrated by my gall bladder case No. 2 and it is in accord with the opinion and experience of Liege and Foliasson.

My sincere thanks are due to the Dean of K.E.M. Hospital and Superintendent of Arthur Road Hospital for permission to use their material and to Doctors Adhia, Vaze and Shah of the K.E.M. Hospital for their great help in getting this large amount of material collected and tabulated — in particular, I mention the help of Dr. Adhia one of my colleagues now at the Hospital, who has worked at it for months.

Dr. Karmarkar, who is associated with me in my surgical unit, has helped me in getting some tables and graphs for this paper, and I thank him.

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### DISCUSSION

V. P. Mehta (Bombay) said that perforation is the commonest complication and the mortality depends on a number of factors amongst which are day of fever, time since perforation, general condition of the patient, anaesthesia used, speed of operation, post-operative blood transfusions, penicillin and streptomycin.

However, in spite of these factors being fairly standardised, the mortality varies with certain surgeons and at certain times and this was explained by the fact that some of these patients that survived have had a previous T. A. B. inoculation even two or three years back or particular epidemics are of a more severe type.

He reported a series of twenty typhoid perforations which had died except one in spite of early diagnosis, local anaesthesia, plenty of blood transfusions, penicillin, streptomycin and an average operating time of 35 minutes. He stressed the possibility that these perforations differ from a duodenal perforation in that there are

many ulcers and so multiple perforations occur and kill the patient, even after one is successfully sutured. This hypothesis could only be ruled out by regular autopsies.

U. P. Sinha (Patna) cited a case record of a typhoid patient where the humerus showed chronic osteomyelitis—both radiologically and clinically. There was a biggish sequestrum in X-Ray. After a heavy course of penicillin the arm became normal. Radiologically the sequestrum disappeared or rather there was no evidence of sequestration, in the final place. He pointed out that the dead bone after the infection had been controlled by penicillin, behaved like an internal graft and got integrated in the original bone and suggested that his orthopaedic colleagues might take advantage of this. In cases of early sequestration due to any type of infection once the infection was effectively controlled the sequestrum behaved just like an internal graft, and got integrated in the original bone, (and suggested that his orthopaedic colleagues might take advantage of this.)

K. Das (Calcutta), discussed about (a) Two cases of dislocation of hip; in one, dislocation occurred when the child made an attempt to walk following rather a severe type of typhoid fever; the dislocation in the other case took place while the boy was still in bed during the convalescence of typhoid fever. He showed the skiagram of the latter case. He laid stress on the fact that pathological dislocation following typhoid fever is often of silent nature. If the practitioner is not aware of this fact, diagnosis can never be made early. Treatment is unnecessarily deferred until a late diagnosis is made when possibly nothing can be done satisfactorily.

(b) Two cases of osteomyelitis; in one, the ulna and in the other the humerus were affected. They were of latent type occurring one and three years after the attack of the typhoid fever. He showed X-ray plates of those cases showing poor bone formation and no tendency to the formation of sequestra.

**D. G. Ojha:** (Bikaner) Inferring from the reports of the bacteriological examination of peritoneal fluid of cases of typhoid ulcer perforation of small intestines in the series reported by Dr. Baliga which demonstrated by culture *B. coli* in seven cases and *B. coli* and *Streptococcus* in three others, and assuming that even if *B. typhosus* were present in the fluid, sufficient immunity should have developed against it, and further learning from the experience of ten cases of acute perforating appendicitis with diffuse peritonitis treated (at P. B. M. General Hospital for Men, Bikaner) with penicillin injections (50,000 units every three hours for 3 to 10 days as necessary) combined with sulphadiazine or sulphathiazole (Cibazol), (1 gm. with alkaline mixture 1 oz. every four hours for the first 1 to 3 days and later every six hours for the next few days as necessary), supplemented with the usual expectant non-operative or conservative line of treatment [viz. high Fowlers' position, local application of heat to the lower abdomen, fasting except for sips of plain or glucose water and later orange juice and then milk diet—once the abscess is well localised and contracting, the use of Ryles tube or Miller Abbot in case of distension of stomach or ileus respectively, and parenteral administration of fluids and nutrition (glucose, amino-acids, plasma, blood)], and further in view of the appal-

ling rate of mortality of operated cases except for those operated upon within the first few hours, he suggested that those cases which do not come to the hospital within the first six hours of perforation of the typhoid ulcer, or even those of the early cases whose general condition is not so satisfactory should not be operated upon but be treated on the non-operative expectant line of treatment with the suitable anti-biotics and chemotherapeutic agents available with us (Penicillin, and "sulphas" usually and streptomycin where possible). He had every reason to hope that the results will be far superior to the reported series of operated cases. Incision of abscesses should be done when indicated.

Dr. Nawab had mentioned two or three instances of localized abscesses due to typhoid perforation which were treated with penicillin with success. He (Dr. Ojha) would rather say that even these cases were to start with instances of diffuse peritonitis which responded to and got localized after treatment with penicillin.

He asked the members present whether any one of them had treated such cases on these lines and if so with what results.

**V. M. Kaikini** (Bombay): Among the late complications of typhoid, bone lesions and joint lesions are easily recognized. But post typhoid late complications of the biliary system are much more common than is usually noted. One finds that about forty per cent of cases of chronic cholecystitis give history of an attack of typhoid fever. It is now acknowledged that for inflammatory lesions of the gall bladder to occur, there must be some abnormal condition of the organ either congenital or acquired, on which the

secondary infection is easily superimposed. The abnormality may be in the organic structure of the gall bladder or in the functions of the nerves supplying it. A perfectly normal organ is rarely affected by any pathological organism. Only two cases are mentioned here as typical ones.

CASE 1. Mrs. T. Age 35. Admitted for severe epigastric and rt. hypochondriac pain. Dyspeptic symptoms and abdominal distress was present for over twelve years. But regular pain with aggravation of the symptoms occurred after an attack of typhoid fever about seven years back. Symptoms became much worse since one year. On opening the abdomen, the gall bladder was found to be slightly enlarged containing a stone, very much fibrosed and adherent to the wall of the duodenum by a short band of thick fibrous tissue. The fibrous band was divided with the knife by sawing through it and the gall bladder was removed. The gall bladder was already abnormal and the typhoid infection was superimposed on it.

CASE 2. Pt. B. Age 14. Admitted for pain in the epigastric and gall bladder area, constipation relieved by big stools containing a large amount of bile, loss of smell and peculiar type of stinging pain in the root of the hair. In 1942 he got stinging pain in the roots of the hair and white stools. He improved after liver injections and other treatment. But the condition again deteriorated and in 1945 he developed jaundice. The jaundice disappeared with treatment. But his general

condition went on getting worse. Gaseous distension, abdominal pain and general debility went on increasing. Radiography showed a badly functioning gall bladder. Penicillin and streptomycin injections were tried without any result. So operation was done in October, 1947, and the gall bladder and appendix were removed. Since then the patient's condition went on improving steadily and he has got rid of most of the symptoms and has started attending his school which he had left for some years on account of ill health.

The peculiarity of this case is that during the period of about one or two years when he started the trouble there were two cases of regular typhoid in the family. He also got fever for about a week which was not diagnosed as any particular type of fever. In my opinion this patient must have had an attack of an abortive type of typhoid and was harbouring the typhoid bacilli in his gall bladder, which gave rise to a persistent variety of chronic cholecystitis. His father also who is a medical man had a mild attack of fever lasting for about four days during this period. And since then he has been suffering from severe dyspeptic symptoms with pain and distress in the upper abdomen. Duodenal ulcer has been excluded by X-ray. So my idea is that both these people suffered from an atypical type of typhoid and the typhoid bacilli lodged in the gall bladder have caused the pathological condition of the organ. An analogous condition is found in the case of amoebic abscess of the liver, where a patient harbours amoeba in his colon without giving any history of a regular attack of dysentery, when he is admitted for the treatment of liver amoebic abscess.



# IDIOPATHIC OR SPONTANEOUS GANGRENE OF THE SCROTUM (FOURNIER'S GANGRENE)

by Y. V. SACHDEVA & B. C. KHANNA, Amritsar.

The following two cases are of interest in that they are examples of a rather uncommon and unusual condition.

## Case Reports

**CASE NO. I:** S. R. 35 H.M. was admitted on 3-12-1948 with a provisional diagnosis in the casualty department of scrotal abscess (?). The complaints on admission were a painful swelling of the scrotum with rise of temperature and drowsiness of only 24 hours' duration. A little more than 24 hours before, the patient felt slight irritation on the scrotum and as he scratched it, he noticed that the scrotum was swollen. This swelling increased rapidly in size, was very painful and was associated with a rise of temperature and marked toxæmia.

On examination the patient was in a severely toxæmic condition so much so that he was nearly unconscious. He would reply to questions with difficulty. The tongue was markedly dry and furred. Temperature 102° F. Pulse 110 per minute and very feeble. Respiration 22 per minute.

Locally the whole of the scrotum was swollen, skin over it being tense and red, but it was already turning black at the bottom of the scrotum where the temperature was subnormal and the feel was boggy. The swelling was limited to the scrotum, neither the penis nor the perineum being involved.

Glucose saline intravenously was started immediately and 2 hours later multiple incisions were made and a lot of sero-sanguinous fluid came out. Penicillin therapy was started.

**Progress report:** The temperature came down the very next day and his general condition began to improve. The gangrenous skin began sloughing off, and by the 25th December, the scrotal\* ulcer was clean enough for skin grafting. Pinch grafting was done on 27th December, 1948. The grafts took and the patient was discharged cured on the 8th January, 1949.

During the whole illness the patient was passing urine normally and the laboratory examination of urine did not reveal any abnormality.

**CASE NO. II:** J. N. 62 H. M. was sent into the ward on 20th October, 1948, in a fairly toxic condition and with a provisional diagnosis of cellulitis scrotum and phimosis (extravasation of urine?). The present trouble started only 2 days previously when the patient noticed a swelling of the scrotum and to a lesser extent of the penis as well, accompanied by severe pain. This swelling increased in size and at the same time the patient's general condition deteriorated.

In the previous history, the only significant fact was that 13 years previously he felt some irritation at the glans penis followed by swelling of the glans and the prepuce. This subsided in a few days time but since that time his prepuce could not be retracted and he noticed a decrease in the size and force of the stream of urine. But since all this time there never was any attack of retention of urine.

On examination, the patient was obviously ill with an anxious and toxic look. There were signs of marked dehydration, his tongue being dry and furred. Temperature was 13.5. F. Pulse was 110 per minute and of low volume and tension. Respiration was 26 per minute.

Locally there was a marked swelling of the scrotum and the penis mainly on its under surface and to a certain extent in the pubic region. The fore-skin could not be retracted back but the patient could pass urine, even though it be in drops. The skin over the scrotal swelling was inflamed and tense and in places it had already turned black. There was a foul smell present.

The patient was too ill to stand much interference. 5% glucose in saline was therefore started intravenously and a few hours later multiple incisions were made into the swelling without any anaesthesia. There was a free flow of turbid, sero-sanguinous foul smelling fluid. The patient was returned to the wards and the glucose saline continued by the drip method. Because his condition was low, about 300 c.c. of plasma were also given and the patient put on sulphadiazine and penicillin.

**PROGRESS REPORT.** Patient's temperature came down the next day after the incisions but the patient continued toxic for the next two days and on the 23rd October developed hiccough. The glucose saline was continued 800-1000 c.c. being given daily. The hiccough stopped after two days and the

\* From the Department of Clinical Surgery, Medical College, Amritsar (East Punjab)

patient's general condition began to improve from the 25th onwards. The gangrenous skin sloughed off in about a month and the testes were left exposed. These were embedded in the surrounding skin by a secondary operation.

When the whole swelling had gone down it was found that there was an old standing phimosis with a stenosed external meatus but the patient could pass urine all right.

Urine showed no abnormality.

### Discussion

The condition was named after Fournier because it was first described by him in 1884. According to him there were 3 essential features present in these cases viz. (i) the sudden onset in an otherwise healthy man, (ii) the rapid progress of the condition and (iii) the absence of any of the usual causes of gangrene. These three, it will be noticed, were present in both the cases described above.

According to Mansfield (1946) a study of the reports of subsequent cases reported in the literature shows that there are certain other factors which are commonly found in a majority of the cases. These are:

1. Extensive and fairly constant area of gangrene. Cases of partial loss have been reported but most of them involved typically the skin of the scrotum and penis. Cellulitis of the abdominal wall does occur in some cases but in most cases it ends in resolution, as in one of our cases. He describes, in addition, three flaps of skin of the scrotum two of them based laterally and one posteriorly which escape gangrene and which according to him are responsible for spontaneous repair. The testis and the inguinal and anal regions are always spared.

2. Rapid resolution of the adjoining cellulitis with a corresponding improvement in the patient's general condition.

3. A tendency for spontaneous repair to occur. This, according to him, is due to the presence of the three flaps of skin noted above which escape gangrene. This unfortunately was absent in both our cases. Pinch grafting had to be done in the first case 24 days after incisions and in the other the testis had to be covered as they were left still exposed more than a month after the incisions had been made.

*Aetiology:* According to Mansfield (1946), there are two theories about its origin. One is that it is a fulminating erysipelas but this is not considered likely by most authorities. The other theory (Gibson) is that it is a gas gangrene due to *B. welchii* or other anaerobes. and it is pointed out that sufficient search is not made to find out the causative organisms. The latter theory is also difficult to accept because one cannot explain the escape of the testicles, and the inguinal and anal regions. We are, however, not in a position to say anything one way or the other regarding these theories because no bacteriological examinations were carried out in either of our cases.

Mansfield puts forward a third theory that the condition is a vascular disorder of infective origin analogous to cavernous sinus thrombosis. The infection has no specificity and it causes a rapid thrombosis of the vessels of the septum of the scrotum. Only in this way can gangrene limited to the skin flaps be explained. This theory seems to us to be more plausible.

*Surgical treatment.* The usual treatment should be multiple incisions with the adjuvant use of the modern anti-

biotics. Mansfield advocates radical removal of all sloughing areas to save time. This should certainly be better if the patient's condition permits.

### Summary

1. Two cases of Fournier's Gangrene are reported.

2. The etiology and the treatment of the disease are discussed.

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## REVIEW OF RECENT PROGRESS

### REVIEW OF PROGRESS IN UROLOGY IN 1948

by S. R. JOGLEKAR, Bombay.

Ever since Millin described his retropubic method of enucleation of adenomatous prostates in 1945, urological literature is full of references to this method. English, European and American surgeons have given extensive trial to Millin's Operation and published their results. No comparable papers by Indian surgeons have however been written as yet, although it is certain that many of them have followed the method during the last four years. During 1948 many papers were published and varying opinions expressed about the retropubic method of prostatectomy. In the *Journal of Urology* of March 1948, a lecture by Millin, followed by a discussion is reported in detail. Millin in his opening address reviews the results of 1,503 cases from various Clinics. The mortality was 5.3% in all cases. He gives his opinion that in spite of certain possible demerits, it is the best method evolved upto the present day.

In the discussion that followed, varying opinions were expressed. Nelson of Seattle, gave a review of his cases and mentioned that the mortality in retropubic cases in his series was higher than in transvesical cases. The complication of suprapubic fistula—said to be commoner after transvesical operations—was very rare in his experience. Still he believed that in selected cases retropubic method may be better.

Bacon of Hollywood is a strong advocate of Millin's method.

Gosse of Halifax, Nova Scotia, advised retropubic methods only in selected cases. He thought that bleeding is much more severe during retropubic operation than one is led to believe from Millin's description.

Davis of Philadelphia, wants that all urologists must be masters of all different

methods and each case has to be judged from many different aspects. No one method, described as yet, is suitable for all cases.

Lowsley of New York, mentions leakage as the chief danger after the retropubic operation; there was also stone formation in some of his cases. In a separate article in the same number (Lowsley and Gentile), he reviews 28 cases with no mortality, no fistula and preservation of sexual power.

Leopold Brodny (*Jour. of Urology*, July 1948), describes a new haemostatic catheter bag for use after prostatectomy. He finds this much more useful and efficient than Filcher's bag. This catheter bag is made by American Cystoscope Makers, Inc.

W. C. Eikner (*Jour. of Urology*, July 1948), recommends strongly a one stage transvesical operation with packing of the prostatic cavity with "Oxycel" gauze or "Gelfoam" around a catheter, for haemostasis and complete closure of the bladder. He reviews 80 cases with successful results.

Reinle and Macdonald (*Jour. of Urology*, September 1948) recommend a slightly different technique from Eikner's, but on the same principle of transvesical approach, packing the prostatic cavity and complete closure of the bladder.

Nesbit (*N. England Jour. of Medicine*, 1947) describes in detail resectoscopic or transurethral resection of the prostate. Two or three sittings may be required and subtotal resection is essential. If this cannot be attained for any reason, some other enucleative procedure should be adopted, as cure of prostatism depends on extirpation of the gland.

Abelhouse (*Jour. of Urology*, 1948) describes cases of heterotopic bone formation after prostate operations though the condition appears to be very rare.

W. Brunner is a strong advocate of Millin's operation. But mentions fistula and infection of the cave of Retzius as the chief dangers.

Gouverneur, Aboulker and Dufour review 70 cases of Millin's operation with two deaths and one case of urinary incontinence. Good exposure is essential and therefore there are great difficulties in obese patients. Infection is a contraindication. Advantage over the perineal method is that the rectum is not injured.

Millin et al (Lancet, March 5, 1949) have put in a strong plea for the retropubic method and have attempted to refute many objections. In their opinion the complication of osteitis pubis, which seems to have become commoner in recent times, is due, not to the retropubic method, as it is found after transvesical operations also, but is due to routine use of penicillin and sulpha drugs which make the skin wound heal and leave behind *Pseudomonas pyocyaneus* and other resistant organisms untouched. They therefore do not recommend routine use of penicillin. This complication, however, is always curable and gets cured. They are against the use of cellulose gauze or alginate packing as in Eikner's method, because retention of urine may be caused by blocking of catheter due to premature separation of fragments and in case there is slow disintegration, there may be difficult micturition on removing the catheter. If replacement of catheter is necessary, great difficulty may be encountered. In the end, the view is expressed that the retropubic method is unsuitable for the "smash and grab" or "dawdling" type of surgeon and the last argument given in favour of retropubic approach is the opinion of a French Surgeon that in spite of certain difficulties and disadvantages—and no method is free from these—Millin's method has given the best results so far.

In a general summing up of all the above mentioned views, it may be said that to-day Millin's method is strongly holding the field. But it may take a few years more before we know that it is going to become

"the method" in future or whether a transvesical operation such as Eikner's or Reinle's will replace it. Perineal and resectoscopic methods, apart from certain selected cases are not favoured by most surgeons in general.

#### STREPTOMYCIN IN UROLOGY

Streptomycin is being very widely used to-day in all kinds of infections. In urology, the opinion on the value of streptomycin, is generally favourable, the necessity, however, for focussing attention on certain complications and contra-indications is still present.

Bandler, Roen and Mulavie (Jour. of Urology, Jan. 1948) recommend its use in urological infections, but caution about neuritic reactions which are present in about 25% of cases. They disapprove of indiscriminate use of streptomycin especially as a prophylactic.

Lazarus, Marks and Schwarz (Jour. of Urology, Feb. 1948) have found that in *Pyocyaneus* infections streptomycin, though not specific, in large doses is of sufficient merit to warrant its use.

Garvey and Canning (Jour. of Urology, July 1948) have made certain observations about the use of streptomycin in urology. These are :—

1. Streptomycin is most useful in *B. coli* infections.
2. Testing the particular strain against streptomycin is of value.
3. It is most effective in alkaline urine.
4. Two to three grms. for 3—5 days only should be given. Longer use is ineffective.
5. Toxic effects should be watched and one must remember that streptomycin is not so safe as penicillin.

Mrazek (Jour. of Urology, Sept. 1948) is of the opinion that streptomycin is useful in 75% of urinary infections. He recommends its use even if the particular strain

s resistant, provided it is one of those organisms on which streptomycin acts.

#### URETHRAL STRICTURE

Attwater (Proceedings of Royal Society of Medicine, Vol. XVI, No. 12, December 1948) has given an excellent account about urethral strictures. He points out its characteristics, such as its extreme gradualness and insidiousness of onset, the cause being mostly bacterial, chemical or traumatic, many times trivial in nature. The use of sulpha drugs and penicillin, and more care in the use of urethral instruments has lessened the incidence. Regular dilatation is the only sure remedy. Operations being traumatic procedures are themselves the cause of stricture. Extreme gentleness and patience in dilatation is essential. The old saying "once a stricture, always a stricture" is only too true. Operation is only indicated if dilatation is impossible, if urinary calculi are present and when stricture is impassable or impermeable. An urgent operation is done only when there is complete retention or when an abscess has formed. That urethrotomy—external or internal—cures a stricture is in his opinion a complete fallacy. The results of operation are often worse than before and the dangers are bleeding, sepsis and recontraction in a worse form. Internal urethrotomy may have a very limited application in rare cases.

Lastly, I would like to bring to the notice of all surgeons especially teachers, the Presidential address of Chas. McMartin (Jour. of Urology, Feb. 1948) in which he mentions the principles in the teaching of urology to undergraduates. These points are not only useful for the teaching of urology, but with suitable modifications, can be applied to the teaching of surgery in general and therefore well worth careful study by all teachers of surgery. They are as follows:—

1. Postgraduate methods are thoroughly unsuitable.

2. The tendency on the part of many of us to make our clinical courses to the undergraduates too much of a show place for highly technical diagnostic and operative procedures is not sound.
3. Commoner urologic disorders or medical urology or "office urology" must not be neglected because of operative urology.
4. Outpatient clinic is more important than operation theatres.
5. Although each specialist thinks his field the most important one, the teacher of undergraduates must not forget that he is endeavouring to fit men to be general practitioners. So only basic fundamentals must be taught.

The practical application of the above principles must result in following the rules given below in the teaching of urology to the undergraduates:—

1. Surgical anatomy must be taught.
2. Careful history taking and general methods of examination and investigation must be insisted on.
3. Lower genito-urinary tract must be taken first and then the higher tract. Revision of anatomy at each stage is very important.
4. Students must realize that they are examining the whole patient and not only the genito-urinary tract.
5. Outpatient clinics are very important.
6. The teacher must work with the students and not over them.
7. All minor procedures to be done by students, (injections, passage of bougies, sounds and catheters) under supervision. The senior teacher must take part in this and not leave it entirely to juniors.

# CASES & COMMENTS

## A CASE OF AIR EMBOLISM\*

by E. W. GAULT and M. BALASUBRAMANYAN, Vellore.

### Introduction

Reports of cases of air embolism are not very frequent in the literature though it is mentioned as a serious complication following various surgical procedures. The condition was first recorded in 1818 by Beauchesne. It followed the removal of a tumour of the neck. Gordon (1920) reported a case occurring after injection of air into the maxillary sinus. Bingel (1923) reported one after air irrigation of a peritoneal pocket in a case of subphrenic abscess. Mathe (1929) reported a case in which air was injected into the urinary bladder to visualize a tumour. Gough mentions a series of cases in the practice of obstetrics and gynaecology. Larson and Nordland (1934) reported two cases of venous air embolism following thyroidectomy. Guthrie and Evans (1933) sent a questionnaire to 38 thyroid surgeons and 15 of them reported 21 cases. Four of these followed block dissection of glands of the neck and 17 followed thyroidectomies. Hamilton and Rothstein (1935) recorded 9 cases following artificial pneumothorax and according to them incidence of air embolism is once in every 500 to 1,000 pneumothorax treatments. Hepler et al (1947) and Hower and Coombs (1948) report cases following radical mastectomy. The following case occurred after excision of the jaw and presented some interesting features.

### Case Report

K., a male aged 50 years, was admitted on 13th September, 1946, for carcinoma of

\*From the Department of Pathology, Christian Medical College, Vellore.

the right cheek. The lesion presented as an ulcer  $\frac{1}{2}$  inch in diameter with everted edges, and involving the alveolar margin of the lower jaw on the right side. The lymph nodes in the submaxillary region and the anterior triangle of the neck were palpable. On 16th September, a block dissection of the lymph nodes and dental extraction was done. On histological examination, the lymph nodes showed congestion but there was no evidence of malignant invasion. Since the primary tumour was found unsuitable for radium implantation, excision of the jaw was done under rectal ether and evipan on 3rd October 1946. About an hour and a half after the operation, the patient's respiration suddenly became bad and the pulse was imperceptible. Soon after he gasped and died.

An autopsy was performed two hours after death. It was noticed that the innominate vein, instead of appearing bluish was of a greyish white colour. The pericardial cavity contained a small amount of serous fluid. The right atrium was crepitant like lung and appeared to contain bubbles of air. While it was being palpated, we noticed a few feeble contractions of the auricle. Attempts to elicit ventricular contractions by massage were ineffective. The chest was filled with water and the heart was opened under water. The right atrium and ventricle contained a quantity of air in fine bubbles. The superior and inferior vena cavae also contained air and more could be expressed out when the finger was run upwards along the inferior vena cava in the abdomen. The left side of the heart did not contain any air. The blood in the heart was fluid. The myocardium was well developed and the valves showed no lesions. The coronaries were patent. The other organs did not show anything of interest.

### Discussion

Two types of air embolism have been described, venous or pulmonary and arterial or systemic. In the case reported by Hepler et al there were both types of air embolism, the air having escaped into the left side of the heart through two inter-auricular septal defects.

Air embolism is apt to occur during a surgical procedure, if a distended vein

having a negative pressure is severed leaving the proximal orifice patent. The veins of the neck are the ones most likely to be entered by air. This is due to the anatomical peculiarity of the venous trunks in this region. In many places they are attached to the deep fascia which prevents collapse of their walls when injured.

Air embolism is fatal in 15 to 50% of cases. The prognosis is said to be good if the patient survives the first 10 or 15 minutes after the accident. The amount of air, in the circulatory system, which is necessary to produce death in man is not known but a small amount may precipitate death in a patient gravely ill. The cause of death in these cases was thought to be due to inefficiency of the cardiac action, affecting the right side especially. Owing to the presence of frothy blood in the chambers the valves are not properly opened and the circulation comes to a standstill. In addition to this there is a diffuse capillary block of the pulmonary vessels by air bubbles, resulting in an acute hypertension of the lesser circulation. Blair and McGuigan found that in every case the respiration stopped first, and the heart in some cases would again resume its function if artificial respiration was given effectively.

In the case recorded here the condition was about to be missed since nothing in the clinical notes suggested the possibility. Simpson has suggested that the diagnosis of air embolism may be missed even at autopsy, if not previously suspected.

This case presents two interesting features. The occurrence of air embolism one and a half hours after the operation

appears rather unusual, though it has been emphasized by Jackson that it may develop several hours after the operation and even after the patient is up and moving about. This is often due to freeing of a ligature from a vein during cough or any act of straining. Besides this possibility it is suggested here that at the time of the operation there was a small injury to a vein providing a trap-door by which blood could not escape but air could be sucked in. This did not occur while the patient was breathing quietly under rectal ether and evipan but probably with increased respiratory effort after operation, air was sucked in through this opening leading to fatal air embolism.

The second interesting feature was the contractions of the auricle. Though the contractions were feeble, they could be kept on with repeated stimulations, for a considerable length of time. How the heart muscle was able to contract two hours after death is difficult to explain. It is possible that death was so sudden, that the myocardium did not have enough time to die. The thin auricular wall probably had enough oxygen supply from the air contained in its cavity, so that the muscle could retain its contractile power for even two hours after the death of the individual. Considering this point it is reasonable to assume that any early therapeutic measure to remove the air from the heart would have saved the patient. Allen, reporting a fatal case, believes he would attempt to aspirate the air from the right auricle, should he encounter the condition again. This ought to be possible by putting a needle into the heart and aspirating, if not by catheterization of the right auricle.



### Summary

A case of air embolism following excision of jaw is reported. The accident occurred one and a half hours after operation and feeble contraction of the right auricle of the heart was noticed at autopsy, performed two hours after death. The relevant literature is briefly reviewed.

### ACKNOWLEDGEMENT :

Our thanks are due to Dr. Lazarus and Dr. Macpherson for their permission to report this case and to the Librarian, Gordon Craig Library, Royal Australian College of Surgeons, for his help with photostat copies of some literature on the subject.

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## A CASE OF MESENTERIC THROMBOSIS

by G. P. SRIVASTAVA. Dehra Dun.

Karam Singh . . . . 32 Years H.M. started complaining of acute pain in abdomen on the morning of 8th May, 1949 with vomiting.

The pain was of very severe nature and constant. Vomiting recurred and the patient developed inability to pass flatus also. He was admitted to Military Hospital, Dehra Dun the same morning where an enema was given with no result.

By the evening his condition had deteriorated a lot. Vomits and pain were persisting and the abdomen was distended. He was transferred to Civil Hospital, Dehra Dun at 5 P.M. the same day.

Condition on Admission : Patient was a thin man with below average health. General condition poor; pulse 100; temp. 98. Hands and feet were cold and clammy. Abdomen was distended. Visible peristalsis was present. Percussion note was resonant in front and dull in the flanks. Peristaltic sounds were heard on auscultation B.P. was 80/52. He had vomited twice since admission. Tra-sentin one ampoule gave no relief. Heart sounds were normal.

### OPERATION at 7-30 P.M.

Under continuous i.v. glucose drip saline and general anaesthesia the abdomen was opened by a midline incision. Peritoneal cavity was found to contain bloodstained serous fluid and in the deeper parts of the flanks and pelvis there was frank blood. A fan shaped portion of the mesentery with a circumference of about 8" was found to be blue and oozing blood. Portions of it were completely black and fragile. The small gut supplied by this portion was distended and blue. Liver was found cirrhotic. At this stage the patient's condition started causing anxiety and therefore without further exploration a portion (about 3 feet) of the gut was excised along with its mesentery and an end to end anas-

tomosis was done and the wound closed without a drain.

POST-OPERATIVE : Intranasal duodenal tube was left in situ. Slow drip of i.v. glucose saline was continued. On the third day of the operation, the patient developed right basal pneumonia and was put on penicillin.

His condition at this stage became critical and the abdominal distention was very distressing.

He however rallied and improved. Normal bowel action started on the fourth day. On the fifth day he started vomiting the glucose water he was given and gradually developed jaundice. The urine examined at this stage showed urobilin present in excess. i.v. drip glucose was continued with penicillin and he was given some other symptomatic treatment.

The temperature gradually settled down and the patient's condition improved. The jaundice disappeared after one week. In all he consumed over two dozen pints of i.v. glucose saline.

He was discharged cured with no complaints.

### Remarks

A case of mesenteric thrombosis is described. It was almost impossible to diagnose the condition. The low blood pressure and cold clammy extremities with fluid in the abdomen within such a short period was very suggestive. Further conservative treatment would have certainly been fatal. The thrombosis was probably due to the cirrhotic liver.

# HYDATID CYST OF THE PAROTID GLAND

by RATAN LAL AGARWALA, Muzaffarnagar.

Manbhari, F., aged 35 years, sweeper was admitted in the District Hospital, Muzaffarnagar on 22-6-1949, with the complaint of a swelling in the left parotid region.

Patient said that this swelling in the parotid region started 3 years back. In the beginning the swelling was of the size of a pea. This gradually increased in size attaining the size of a small orange now. She had no pain from the very beginning.



Fig. 1.

"Front view of the patient." After the operation. Facial paresis. Left eye is open. Angle of the mouth deviated.

## General condition good

**Local Examination** Well defined tense cystic swelling in the left parotid region extending upto the zygomatic process above, vertical ramus of mandible in front, mastoid process behind and sternomastoid muscle below; superficial to masseter and sterno-cleido mastoid muscles; moveable and non-tender.

Patient was diagnosed as a case of parotid cyst and was advised removal.

On the table, it was found that the parotid gland had become papery and was spread out on the surface of the swelling. The cyst was en-capsuled. It was removed in toto saving the facial nerve and its branches as far as possible. The space was washed with formaline and closed.



Fig. 2.

"Side view of the patient." Operated scar along the posterior border of left vertical ramus of mandible extending upto the angle. 'X' mark denotes the site of cyst. Facial paresis.



Fig. 3.

"Photograph of the contents of the specimen" Showing daughter, grand daughter and great grand daughter cysts and part of the cyst wall.

As the cyst was very adherent, some of the zygomatic and buccal branches of the facial nerve were cut during removal, even though every care was taken to save the facial nerve and its branches.

*Post-operative Course.* The skin united completely. Paresis of the nerve is clearing up gradually.

The cyst removed was full of daughter and grand-daughter cysts.

#### Remarks

Hydatid cyst can occur in any part of the body but it has got preference to liver,

lungs, pleura, breast and bones etc. I have gone through the literature but no case of hydatid cyst of parotid gland is recorded as yet. Ofcourse, it is difficult to diagnose it except on the operation table. The presence of this in this patient, who is a sweeper by occupation, is very suggestive of its occurrence in that class of people who come in contact to dogs.

I am thankful to Capt. S. K. Biswas, Civil Surgeon, Muzaffarnagar for permitting me to publish this case.

#### REVIEWS OF BOOKS

*A Textbook of Bacteriology.* By N. G. Pandalai, M.D., D.T.M., F.R.C.P. (Edin.), Pp. 748. Price Rs. 18/-. Bangalore City. The Bangalore Printing & Publishing Co. Ltd., Mysore Road.

This handy textbook on bacteriology is a welcome addition to the few medical books published in India. Great attention has been

paid to detail and the subject is dealt with exhaustively. It is an excellent guide to the junior teacher in Bacteriology. But as a text book for undergraduate students, it is too elaborate. Emphasis on and statistics of, bacterial diseases as they occur in India would have lent colour to the book.

R. A.

vice at Kasauli. It is expected this unit will start functioning before the end of the year.

To make use of microfilmed articles, medical colleges, research institutes, libraries, etc. will require a "Reader." The cost of a "Reader" is approximately Rs. 500/- and can be obtained from Messrs. Kodak & Co., Ltd., Kodak House, Hornby Road, Bombay. It will, however, be necessary to obtain an import licence for this equipment before placing the order with the firm.

The Indian Research Fund Association have also sanctioned funds for the setting up of a Photostat Unit along with the Microfilm Service Unit at the Central Research Insti-

tute, Kasauli, to supply photostat copies of microfilmed articles to the institutions requiring them. The necessary equipment required for the unit has not so far been received. When the unit is set up, it will be able to supply photostat copies of microfilmed articles to members of the microfilm service scheme at a charge of one anna per page plus postage.

The Secretary, Indian Research Fund Association, Central Secretariat, New Delhi, would be glad to receive applications from institutions, libraries, etc., for membership of the scheme and to supply any further information required on the subject.

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DECEMBER 1949

## HYPERPARATHYROIDISM

### Generalized Osteitis Fibrosa

by R. MAHADEVAN, Madras.

#### Introduction

The recognition of "Hyperparathyroidism" as the aetiological factor for "Generalized Osteitis Fibrosa Cystica" had certain dramatic features. Patients with marked skeletal deformities and pathological fractures serious enough to cripple them, were found to have an adenomatous enlargement of one or more of the parathyroid glands. The removal of these resulted in dramatic and remarkable improvement. Prior to this knowledge, majority of these patients had to remain bed-ridden cripples, till death. The discovery was therefore of great significance. It, however, led one to think of hyperparathyroidism in terms of skeletal deformities. With further knowledge, certain well recognised biochemical changes came to be looked upon as necessary associates of the condition. The bones of the body got thinned out, softened and demineralised as it were, the circulating blood got overloaded with the calcium removed from the bones, and the increased calcium was carried to the kidneys to be excreted there. Thus, the urine showed excess of calcium, sometimes as much as eight times the normal. The heavy burden of excreting all the excess of calcium fell on the kidneys, with inevitable disturbance of their function coming on sooner or later. The damage to the kidneys had its repercussions on the general system as a whole. Thus, another disease of endocrine origin with remarkable features, came to be added to the already fascinating subject of endocrinology. An adenoma or hypertrophy of the parathyroid glands (the smallest known of the endocrines) could produce far reaching skeletal and other changes.

Observations and follow up of a large number of cases over prolonged periods, experimental researches and biochemical work have shown that the initial idea while correct in the main required some modifications in the light of further knowledge. It is now known that there are other features of the disease which are possibly the earlier or the initial disorders and occurring long before skeletal changes are evident. These are :

1. Aching pains all over the body.
2. Muscle pains with hypotonicity of the muscles.
3. Pressure symptoms on the nerve roots.
4. Renal symptoms, result of renal damage, metastatic renal calcification, recurrent formation of renal stones, etc. (the so-called "renal type" of "hyperparathyroidism"). Bony changes may be absent.
5. Metastatic calcification occurring in the lungs, gastro-intestinal tract, myocardium, etc.
6. Acute gastro-intestinal symptoms with minimal bony changes, only autopsy revealing the true nature of the conditions ("masked hyperparathyroidism" or "acute hyperparathyroidism").
7. Pathological fractures even before the deformities become obvious.
8. There is also a suggestion that some cases of "rheumatoid arthritis" have an underlying basis of hyperparathyroidism. (Helfet, 1940).

The disease generalized osteitis fibrosa is often known as "Von Recklinghausen's dis-

vice at Kasauli. The start function had previously recognised the

To all but Von Recklinghausen seems to have been the first to have adequately and accurately described it and to have differentiated it from osteomalacia. He thought it to be a juvenile form of Paget's disease. His article appeared in 1891 in a Commemoration volume published in honour of the 71st birthday of Virchow. As early as 1904. Askenazy associated the condition with parathyroid tumours (Hunter & Turnbull, 1931) and in 1915 Schlagenhauser (Hunter and others, 1931) suggested extirpation of the tumour as a therapeutic measure. Yet, it was not until 1926 that the first operation for the condition was performed. In that year Mandl removed a parathyroid adenoma from a patient of his, a man of 38 suffering from generalized osteitis fibrosa (Hunter and others, 1931). Hanson in 1924 and Collip in 1925 showed the existence of a parathyroid hormone since called "parathormone". Their work clearly showed that the hormone is responsible for the control of calcium metabolism. Generalized osteitis fibrosa and its curability by removal of a parathyroid adenoma became more generally known, largely due to the work and writings of Hunter, Turnbull, and Walton in U.K. and Ballin and Morse in America.

Further, with increasing knowledge of the disease, it has even been suggested that the primary action of the parathyroid hormone is on the kidney, the blood and bone changes being secondary. It must, however, be stated that the injections of the hormone produce typical changes even after double nephrectomy in experimental animals (Samson Wright, 1947). Another important landmark is the recognition of the condition designated "polyostotic fibrous dysplasia" or "Albright's syndrome" characterised by widespread but predominantly unilateral skeletal lesions, pigmentation of the skin corresponding to the area of distribution of nerve segments and in some cases precocious puberty. This last feature was thought to occur only in some of the female cases but is now known to occur in either sex occasionally (Warwick, 1949). This syndrome is not associated with parathyroid adenoma but its exact causation remains a mystery.

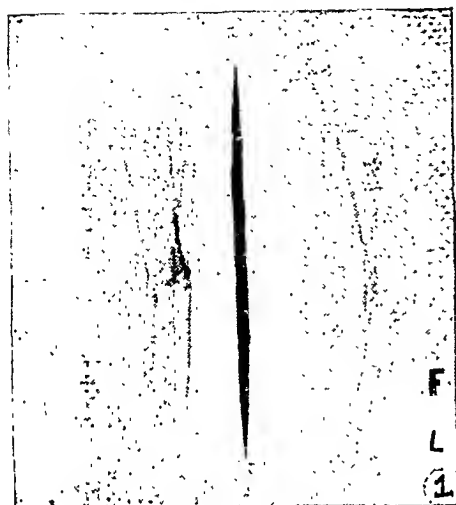
The article herein contributed sets forth the features of two cases of hyperparathyroidism with generalized osteitis fibrosa. Both the cases were operated upon, parathyroid adenomata found and removed. The following features of one of them is detailed. Two other cases with multiple bony deformities and other ailments highly suggestive of hyperparathyroidism, but where the enlarged parathyroids could not be located at operation, are also described as they showed certain unusual features. A brief mention of two cases of solitary cysts of bones is also included as these bring out clearly some points of differential diagnosis.

### Case Reports

CASE I. J. V., an Indian Christian boy of about 17, was admitted on 26-11-1946 with the history of aching pain all over and for deformity of the back, forearms, and lower limbs. The trouble started five years earlier, with aching pain particularly in the lower limbs and severe enough to prevent him from taking part in the school games. He was, however, managing to walk to the school and back covering a total distance of about 5 miles every day till May, 1945, when, as a result of an accidental fall from a charpoy, he developed severe pains in both the legs and became unable to walk thereafter. When he tried to walk a few days later with the help of a stick, he felt as if his legs were bending and soon he was unable to walk even with the help of sticks. After 11 months of various remedies tried at home, finding no benefit, he reported to hospital for treatment.

He was ill-nourished, pale, quite unable to sit up or stand, had a painful swelling and bend of left leg, coxavara of both hips and kyphoscoliosis. The spleen was enlarged. Figs. 1, 3, 4 and 5 are skiagrams taken at the time of admission showing the condition of the left leg, spine, pelvis and femora. The extensive decalcification is shown well, particularly in the bones of the left leg which show also a pathological fracture of both tibia and fibula about the middle. He had also bending of both forearms with pathological fracture of both ulna. Skull bones looked normal. The blood calcium was high (but unfortunately the figures are not with me now). The blood W.R. was negative. There was no palpable swelling in the neck, corresponding to a possible parathyroid swelling. Skiagrams of genitourinary tract showed no calculi.

Operation on 6-2-1947. Regional and local novocaine block (supplemented by general anaesthesia for osteotomy of tibia); collar incision—upper pole of right thyroid lobe released when a soft mass, in colour like that of a parathyroid about 5 m.m. x 4 m.m. was seen. This was



Figs. 1 &amp; 2.

Fig. 1. Shows skiagram of left leg at time of admission (25-11-46) showing the extreme demineralization of the bones and a pathological fracture of tibia and fibula. Fig. 2. Shows the condition on 26-8-47, 7½ months after parathyroidectomy and osteotomy. The increase in density of bones is clearly shown.



Figs. 3 &amp; 4.

Figs. 3, 4 & 4a. Show skiagrams (soon after admission) of the spine, A.P. and lateral views. The scoliosis and the biconcave shape of the vertebral body and the biconvex (fish-shaped) shape of the inter-vertebral discs are shown.



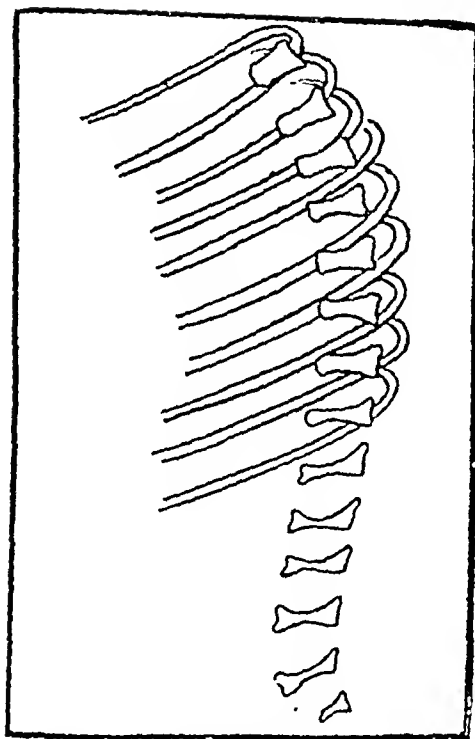


Fig. 4a.

removed. The lower and posterior aspect of the right lobe released and examined, but no parathyroid tissue could be found here. An identical dissection was done on the left side when a parathyroid adenoma of the size of a tamarind seed was found behind the posterior aspect of the thyroid lobe. It was quite distinct from the thyroid and much less reddish in colour. It was removed and incision closed with a drain. Now, under general anaesthesia the tibial deformity was very easily corrected by exposing it by a curvilinear incision over the subcutaneous aspect of the tibia. The bone was very soft and crumbling, cutting as it were through wax, or rotten wood. Limb encased in plaster after corrective moulding. Fig. 7 shows a microphotograph of the parathyroid adenoma. Figs. 1 and 5 show skiagrams of leg and hip before operation and Figs. 2 and 6 show the condition 7½ months after operation. The remarkable improvement in the density of the bones is very well shown.

Within 2 or 3 days after the operation, the boy felt great relief from the aching pains which he had for years. Figs. 8 and 9 show his condition soon after he was able to walk about and Figs. 10 and 11 the condition about another 8 months after. He was discharged home sometime after he was able to walk in comfort and was last seen on 13-4-1948 (Figs. 10 and 11). He was able to walk about well but his general condition had received a setback largely due to want of food



Fig. 5.



Fig. 6,

Fig. 5. Shows the condition of the hip and femur at the time of admission and Fig. 6, 7½ months after operation. The increase in the density of the bones is again brought out clearly.

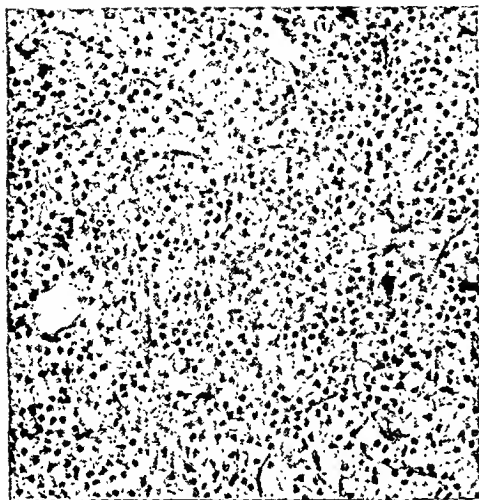


Fig. 7.  
Shows microphotograph section (x 200) of the  
adenoma removed.

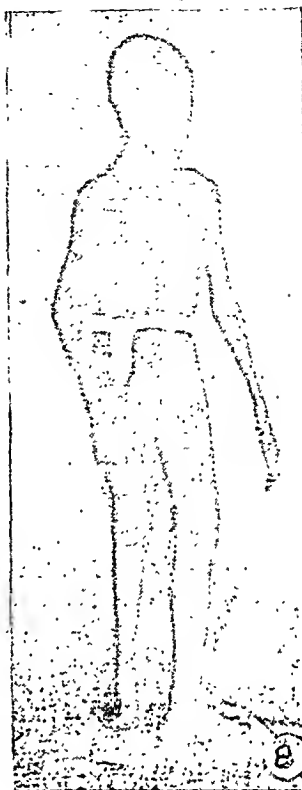


Fig 8

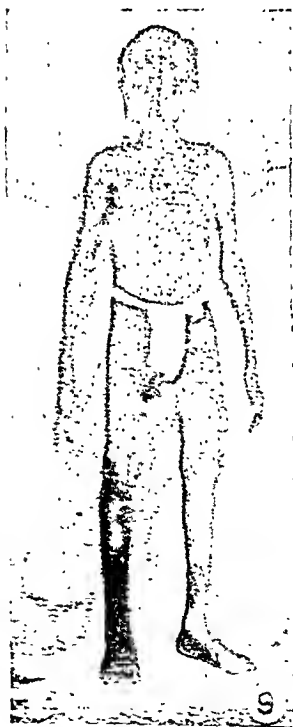


Fig. 9



Fig. 10



Fig. 11

Figs. 8 & 9 show the patient 6½ months after operation (on 6-2-47) and Figs. 10 & 11, 14 months after operation. Fig. 11 shows also the enlargement of the spleen which the patient had.

at home. The enlarged spleen is evident in Fig. 11.

### Discussion

The aching pain which the boy had for years, before operation, disappeared within a day or two after operation. This is a really remarkable phenomenon which has been noted by almost all writers on the subject but as to how exactly this beneficial effect is brought about is not known.

Further, within a few months of the operation the density of bones improved remarkably. (See Figs. 1, 2, 5 and 6). The pathological fracture of the leg has united well and the epiphysis in the region of the femoral neck has fused firmly. Such improvements have been noted by many observers, but it is interesting to recall that in Mandl's case (the first case of parathyroidectomy) no increase in density of bones occurred even 3½ years after operation, though several other remarkable improvements occurred in the general condition of the patient. Thus, his pain disappeared and he was able to walk about with the help of a stick while before operation he was totally disabled. His weight increased by 16 kilos and urinary calcium excretion dropped to 1/8th of the pre-operative value. Indeed, Hunter and Turnbull (1931) in their abstract of 28 published cases and of four others discussed by them, mention about the bony changes after the operation specifically in eleven. Six of these showed no improvement in the density as judged from skiagrams while the other five showed improvement. Out of these eleven cases, in ten, blood calcium had come down to normal or below normal level, but in Mandl's case the blood calcium which was 18.2 m.gms. before operation remained at 13 to 14 m.gms. per cent after operation. Is it likely that another adenoma of the parathyroid had been left behind? The remarkable improvement that had followed the original operation is somewhat against this idea.

Another interesting feature in Case I is the evidence of a diffuse resorption of the skeleton and the entire absence of any cyst formation (see the various skiagrams, Figs. 1 to 6). However, it is now known that cystic changes come on late in the disease and their presence

is not essential to the diagnosis. (Hunter, 1938).

CASE 2. P. A. a Hindu girl aged 8 years was admitted on 17-8-1946 with obvious deformities of both thighs and swelling and pain particularly marked in upper part of right thigh. The condition seemed to have its beginnings several months earlier, after a fall. She was bedridden for about a year at home. At the time of admission, her general condition was fair but she had aching pain and tenderness all over the bones. The various deformities and bony changes with resorption and cystic formation in places are shown in the skiagrams of pelvis, hips, femora, skull and hand (Figs. 12 to 18). She was quite unable to stand at the time. Figs. 12 and 13 show the condition after parathyroidectomy, at a time when she had improved enough to be able to stand.

The blood calcium showed the following readings:

(1)	17-1-1947	..	13.74 mgm %
(2)	14-3-1947	..	10.42 mgm %
(3)	9-4-1947	..	13.9 mgm %
(4)	26-5-1947	..	11.19 mgm %
(5)	3-7-1947	..	13.9 mgm %

Average Normals

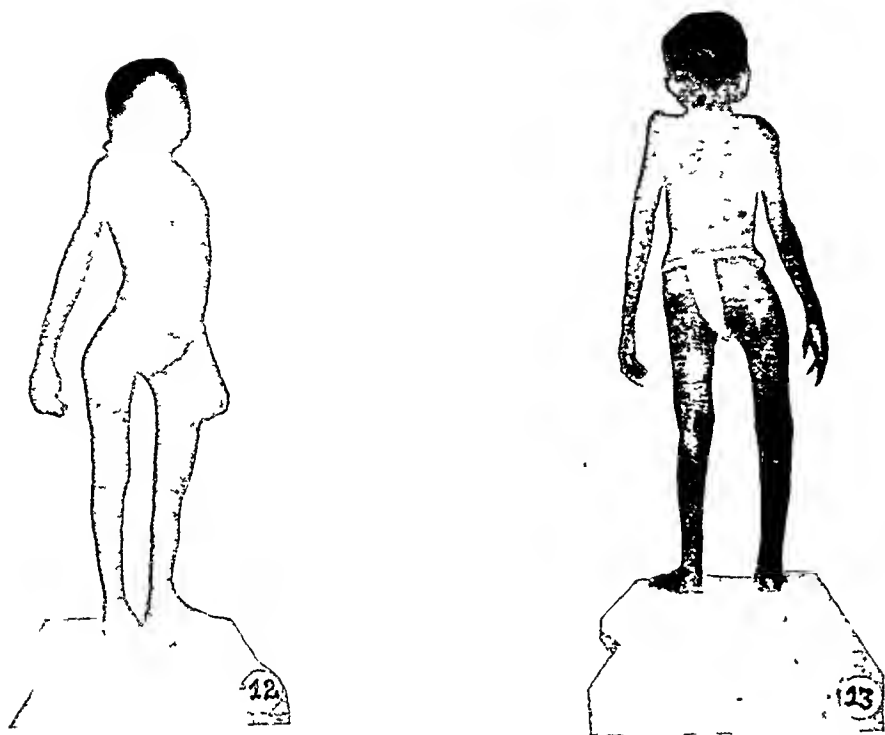
Blood		
cholesterol	149.7 %	160 mgs %
Urine calcium	35 mgms in 71 c.c. (50 mgms in 100)	5-7.5 mgs %
Serum Protein	5.25 mgm %	6.8 mgs %
Blood urea	16 mgm.	30 mgs %

The patient had no symptoms of renal calculus, nor was there any evidence of calculi in skiagrams. There was no palpable swelling in the neck.

1st Operation on 13-2-1947. What was thought to be a parathyroid adenoma was found behind the lower pole of the right lobe of the thyroid. The nodule was extending behind the oesophagus and was freed from this position and removed. Before an exploration on the left side could be performed, the general condition of the patient was found to be bad. Consequently, the necessary further exploration had to be postponed. Histological examination of the material removed showed it to contain only thyroid tissue. No parathyroid tissue was found in it.

2nd Operation 14-6-1947 (4 months after first operation). Left lobe of thyroid gland was dissected up, and about the middle of its posterior border an enlarged parathyroid gland about 12 m.m. by 4 m.m. was found and removed. Histological examination confirmed the tissue removed as parathyroid. Fig. 19 is a microphotograph of section of bone removed at the time of an osteotomy and shows the changes suggestive of osteitis fibrosa.

Post-operative course was uneventful. There was no post-operative tetany. The aching pains disappeared. Before the various deformities



Figs. 12 &amp; 13.

Figs. 12 & 13. Girl aged 8 yrs about 2 months after operation, when she was just able to stand up



Figs. 14 &amp; 15.

Fig. 14 & 15 show skiagrams of pelvis, hip and femur (on 26-8-46) soon after admission. The resorption of bones, the bilateral coxa-vara & the pathological fracture of the shaft of the femur are all well shown.



Fig. 16.

Pathological fracture of the shaft of the femur A.P. and lateral views.

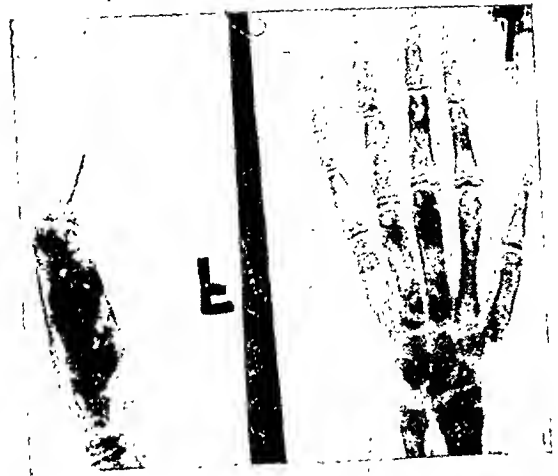


Fig. 18.

Skiagrams of the hand showing resorption as well as multiple cyst formation in the phalanges.

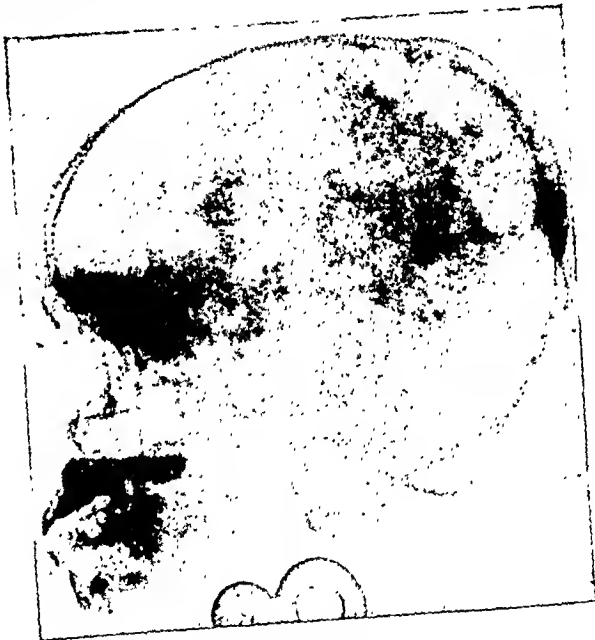


Fig. 17.

Skiagram of skull (26-8-46) soon after admission. The resorption of bone particularly in the occipital area is shown.

could be corrected as well as one could have wished, the parents insisted on taking the child home and she was discharged on 19-8-1947. Attempts at follow up have so far failed.

### Discussion

Hyperparathyroidism may occur at all ages but most commonly in middle life, majority between the ages of 30 and 60. The extreme ages so far recorded are 13 and 69 (Cameron, 1947). But the girl reported here was only



Fig. 19.

Microscopic appearance ( $\times 50$ ) of bone removed at the time of osteotomy of femoral shaft, showing gradual replacement of bone trabeculae by vascular fibrous tissue.

8 years of age (See figs. 12 and 13) and case No. 3 reported below was even much younger being only 5 years old.\* (See fig. 23)

The onset of the disease is usually insidious, though a varying duration of 1 week to 27 years or more has been recorded. A his-

\* Since writing this article reference is found regarding the occurrence of the disease in a child of  $2\frac{1}{2}$  years. (Thomas, 1949—refers to a case under the care of Landon).



Fig. 20.

Skiagram of patient with localised osteitis fibrosa at the time of admission. Note the absence of demineralization in areas other than of cyst formation. At operation the contents were like cocoanut kernel, quite different from the soft rotten-wood like matter met with in generalized osteitis fibrosa.

tory of 39 years has been recorded in one case (Albright, 1934) and 44 years in another (Coburn, 1944).

There was no evidence of postoperative tetany in either of the above two cases. It is said that in some of the cases, after operation, though there may not be any clinical evidence of tetany, masked or sub-clinical tetany may be present. This may be evidenced only by relevant biochemical investigations. Anyhow it is a wise precaution to give these patients a diet rich in calcium, as a part of post-operative regimen. It is also said, that the development of post-operative tetany is not necessarily due to removal of all functioning parathyroids. It is suggested that the presence of an adenoma tends to inhibit the functions of the normal parathyroid and post-operative tetany is a consequence of the normal parathyroids having gone to "sleep" as it were.

If the crisis is tided over by injections of calcium and parathormone, recovery will usually occur. Vit. D administration also is very helpful.

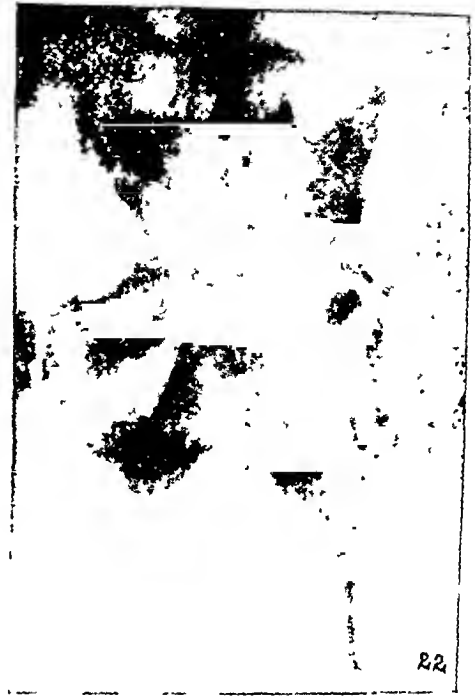
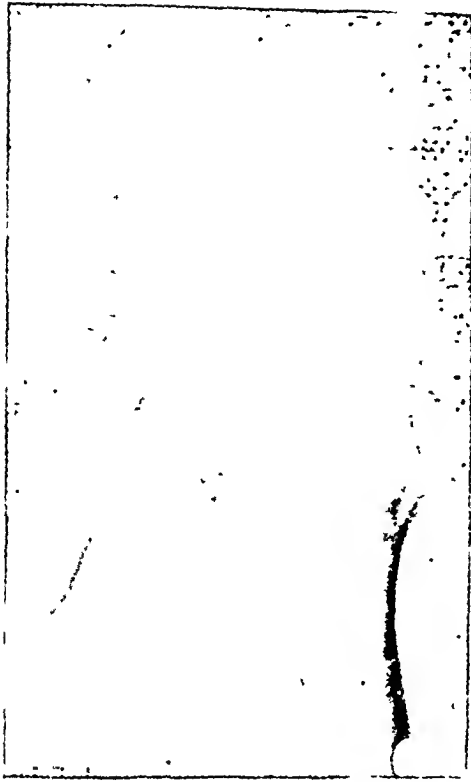
While in case 1 there was no evidence of cyst formation, case 2 showed diffuse resorption of bone in femora, pelvis, etc. (figs. 14 and 15) and also cyst formation in skull (fig. 17) and in bones of the hand (fig. 18) and feet. The appearances in these, particularly the extreme resorption and the pencil outline denoting the cortex (especially as seen in fig. 1) are in marked contrast to the X-ray appearances of simple bone cysts seen in figs. 20 and 21. Figure 20 shows X-ray appearance of a case of localised cyst of bone in femoral shaft abutting on to the neck, in an adult. He came for local pain. The contents of the cyst were very much like cocoanut kernel. Figs. 21 and 22 show a similar case with a pathological fracture. Immobilisation after osteotomy (fig. 22) caused marked improvement in him. In neither case was there any suspicion or evidence of hyperparathyroidism. Mere curreting in one case and osteotomy in the other gave all the relief required.

CASE 3. S. a Mohammedan girl of 5 years was admitted on 21-5-1947 for multiple deformities. Family history nil relevant. There were no blue sclerotics. She never learnt to walk and just began to crawl, only at about the age of 1½ years, when a fracture of femur occurred and some months later she got a fracture of left humerus also. She thus got multiple fractures with resultant deformities and was never able to stand by herself. Fig. 23 shows the condition at the time of admission. Figs. 23 to 26 show the multiple fractures and the extensive resorption or demineralization, particularly marked in spine with biconcave vertebral bodies and the ballooning of the intervertebral disc spaces.

Blood calcium was 12.24 mgm %. Both W.R. and Khan negative.

On 10-6-1947 what was thought to be parathyroid tissue from behind the upper and lower poles of right thyroid lobe and a fairly large one from behind lower pole of left lobe were removed. About this latter one, a suspicion was entertained that it may be thymic tissue. Pathology report—Thymic tissue.

On 26-8-1947—osteotomy of shaft of left femur. The bone was very soft. Unfortunately the relatives took the child home before another attempt could be made to remove the parathyroid. The child is now (12-8-1949) known to be alive with persistence of deformities. The failure to find the parathyroid gland in this case, the failure



Figs. 21 &amp; 22.

Show skiagraphic appearances in another case of localised osteitis fibrosa with pathological fracture before (Fig. 21) and after osteotomy (Fig. 22).

to find it in case 2 in the first attempt and the successful removal of it at the second attempt are all discussed below.

**CASE 4.** B. P. Hindu female aged 40. This case was interesting as several features suggested a clinical diagnosis of hyperparathyroidism, but blood calcium was not high. (It was only 8.4 mgms. %). The deformities were extensive. She had aching pain all over and was bedridden with knees and hips flexed up. There were evidences of old pathological fractures of several ribs on both sides (Fig. 27). The skiagram of pelvis (Fig. 28) suggests resorption and subsequent recalcification. There was no evidence of any primary growth anywhere. Possibly the condition was one of arrested hyperparathyroidism. Indeed, remissions in the course of the disease are known to occur similar to remissions in toxic goitre. The blood calcium was not high, but if the calcium intake is low or if the kidney excretes the calcium quickly or if hypoproteinaemia is present the blood calcium level may not be raised. (Rynearson, 1940).

A possibility of hyperparathyroidism was therefore entertained and an exploration of the neck was performed. Even with extensive search, no parathyroid adenoma could be found. A second exploration was performed a few days later,

opening up the superior mediastinum but no parathyroid adenoma could be detected here either. The patient died five days later and unfortunately no autopsy could be obtained.

### Discussion

In case 3, no parathyroid adenoma could be found and in case 2, it could be found only at the second operation. In case 4, the parathyroid could not be found even at a second operation.

This difficulty in finding the parathyroid has been commented on by almost all writers on the subject. Normally, the parathyroids are situated close behind the posterior border of the thyroid lobes, and are brownish in colour with a tinge of yellow, contrasting sharply with the deep red brown of the thyroid. About 10% of the parathyroids are within the thyroid capsule and occasionally they may be buried in the substance of the thyroid (Walton, 1931). In 22% of the subjects one or more parathyroids occur in the



Fig. 23.

Shows condition of a girl of 5 years at time of admission. The patient was quite unable to stand and had to be held up by two people for enabling the photograph to be taken.

upper pole of the main thoracic thymus, or its involuted remains. Consequently in cases where an expected adenoma cannot be found, removal of the thymus has been recommended. Indeed, thymectomy is indicated under such circumstances. A normal parathyroid has been found embedded in the thymus opposite the auriculo-ventricular groove and sometimes quite high up in the carotid sheath 2 c.m. below the bifurcation of the common carotid artery. Occasionally, a parathyroid may lie behind the clavicle and very rarely even behind the oesophagus. Rose points out that the parathyroids are sometimes found lateral to the thyroid or even on its anterior surface (Cameron, 1947). It must also be remembered that many nodules resembling parathyroid tissue on section turn out to be either lymph glands, aberrant thymic tissue, fat or an adenoma of the thyroid. In fact, Hunter (1938) says that after partial thyroidectomy, identification of parathyroid tissue in the thyroid removed, is very difficult, and an experienced surgeon may prove to be correct only in 5% when checked histologically.

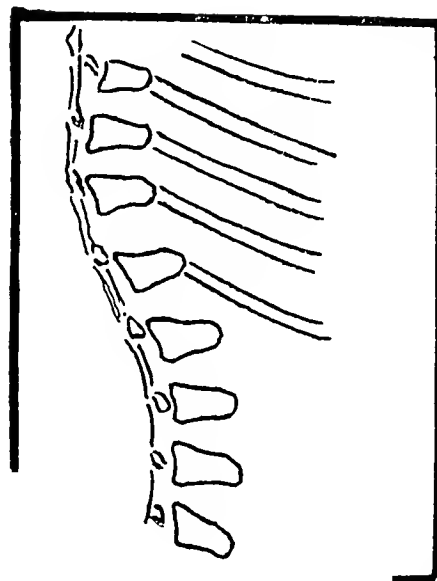
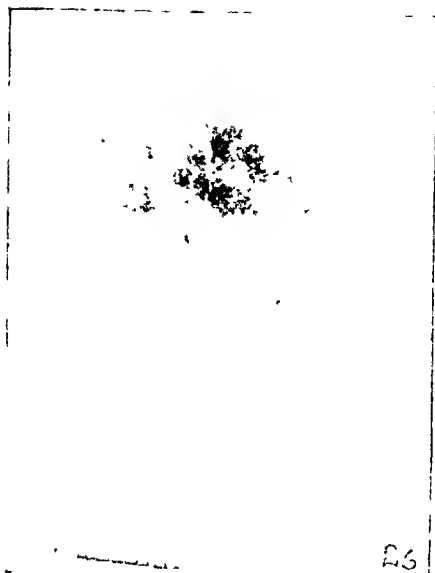
Indeed, in a given case if the clinical and biochemical features suggest hyperparathyroidism and an adenoma is not found at operation, it does not negative the diagnosis of



Figs. 24 &amp; 25.

Show the various deformities and multiple pathological fractures of the femora.





Figs. 26 &amp; 26-A.

Lateral view of spine. Note the extensive bone resorption of the vertebral bodies, with biconcave shape and ballooning of the intervertebral disc spaces.



Fig. 27.

Showing multiple pathological fractures of ribs on both sides.

hyperparathyroidism. As Churchill and Cope (1936) remark all that the surgeon is privileged to say after a fruitless search is that "the tumour cannot be found" but not that "the tumour does not exist". Even the demonstration of four normal parathyroid

bodies is not adequate, because there still remains the possibility of a small adenoma of a fifth gland lying tucked away in some inaccessible region of the mediastinum (Churchill and Cope, 1936). In a case reported on by Churchill and Cope they successfully removed the parathyroid adenoma only in the seventh attempt. These factors clearly bring out the various difficulties that may be encountered and the enormous perseverance and patience required of both surgeon and patient. In locating a parathyroid adenoma, adequate exposure, transverse division of ribbon muscles and search in the mediastinum are helpful factors to be remembered. A meticulous haemostatic field is essential as a blood-stained parathyroid can easily be missed. Lahey recommends that the inferior thyroid artery be followed down to see if it gives a branch to the mediastinum, for such a branch may lead to an adenoma in the mediastinum or below clavicle (Lahey, 1945). It is important to remember that where a parathyroid adenoma is not found, the removal of normal parathyroids is not only of no use, but complicates matters if the adenoma is found at a second operation and has to be removed. The previous removal of a normal parathyroid enhances the occurrence of post-operative tetany. Indeed, 30%

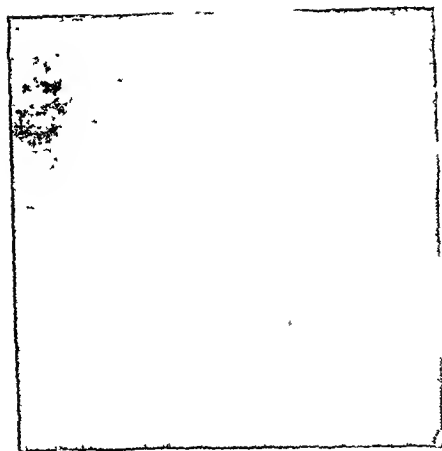


Fig. 28.

Shows skiagram of pelvis ? due to arrested hyperparathyroidism.

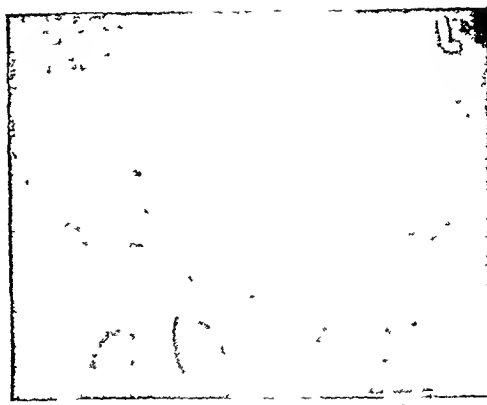


Fig. 29.

Shows vesical calculus and ? metastatic calcification in right ureter in a boy of 11. Investigations did not confirm the metastatic calcification or show any evidence of hyperparathyroidism.

of deaths recorded after operation have been due directly or indirectly to interference with one or more normal parathyroid bodies. If the normal parathyroids appear thinned out, it is another indication that there is an adenoma elsewhere, for the presence of an adenoma is said to result in disuse atrophy of the uninvolved glands.

In none of the cases discussed here was there any palpable swelling in the neck. In the large majority of cases reported by others also, no palpable swelling was present, though at operation parathyroid adenomata were found. A palpable swelling has been present, in less than 20 % of cases reported. Even the largest tumour removed, which measured 7.5 x 5 x 1.8 cms could not be felt in the neck because it was behind the trachea and oesophagus, opposite the bodies of first and second thoracic vertebrae, well below the level of the clavicles (Case 4 of Hunter and Turnbull's original article, 1931). It is rather interesting to note, however, that in an occasional case where a swelling in the neck was palpable, repeated palpation had precipitated acute parathyroid intoxication (Hanes, 1939 quoted by Cameron, 1947).

#### THE NATURE OF PARATHYROID CHANGE IN HYPERPARATHYROIDISM

The parathyroid tumour is almost always a benign adenoma. Usually only one of the glands is involved. The degree of enlargement varies, but on an average it is 3 to 8 times the normal before serious symptoms are manifested. Occasionally there may be enlargement of a second or even a third gland. If these are missed at operation, recurrence of symptoms may occur. In some cases, there is only a generalized hyperplasia of all the parathyroid glands and no adenoma, but this is considered rare.

Malignant tumours with hyperparathyroidism have been reported, but this again is unusual. The few malignant tumours reported in the literature, usually were in patients displaying no evidence of hyperparathyroidism. However, it is interesting to note that in 13 of 14 cases of a series reported by Alexander and others (1943), the parathyroid tumour showed cytologic evidence of malignancy. In the present state of our knowledge, such frequency must be considered an exception rather than the rule.

### MANIFESTATIONS OF HYPERPARATHYROIDISM OTHER THAN OF BONE INVOLVEMENT

As already mentioned in the opening paragraph, the bony changes in hyperparathyroidism are the features that had originally received marked attention. The various deformities due to softening of the bones, or due to pathological fractures compel easy recognition. Histological examination shows in these cases, generalized osteoporosis and lacunar resorption, fibrosis of marrow and formation of osteoclasts and cysts. These features are all only too well known now to require any elaborate description.

What is perhaps not so universally realized is regarding the other pathological manifestations of hyperparathyroidism. These conditions do not seem to be a rare or mere occasional manifestation either. On the other hand, there is accumulating evidence that these may be the more common (e.g. renal type of hyperparathyroidism) and the bony changes may be altogether absent or minimal. Sometimes, the characteristic bony changes come on as later developments. Of these, renal type of hyperparathyroidism merits detailed description. The other manifestations of a general nature, like lassitude and muscle pains or of gastrointestinal manifestations like anorexia, vomiting, constipation, abdominal pain, etc., have been already mentioned and require no further elaboration. A few other rarer manifestations with a possible underlying basis of hyperparathyroidism are also briefly mentioned.

#### RENAL TYPE OF HYPERPARATHYROIDISM

Albright and his associates (1934) by a study of their cases of hyperparathyroidism and cases of renal calculi came to the conclusion that hyperparathyroidism is the etiological factor in the formation of renal calculi in an appreciable number of cases. Their subsequent experiences and the experience of others substantiated these views. Indeed by 1942, Cope was able to report on 67 cases of proved hyperparathyroidism and in fully one-third of these cases evidence of skeletal involvement was altogether lacking. After the writings of these people and when diagnostic criteria were placed on a basis other than merely looking for skeletal changes, in 2½

years 24 cases of hyperparathyroidism were detected at the Mayo Clinic, in contrast to 14 cases observed during the preceding 14 years in the clinic. In these 24 cases, disease of the bone was more or less evident in some 67%, whereas renal calculi or calcification of the kidneys occurred in 92%. (Keating and Cook, 1945).

Alexander, Pemberton and others (1943) say that in their experience the incidence of renal lithiasis in hyperparathyroidism is about 60%. They also say that the bony changes in hyperparathyroidism appear to be an index, more of duration of the disease than of its severity. Cope considers that 10 to 15% of cases of renal lithiasis are due to hyperparathyroidism. In a few cases of hyperparathyroidism an abnormally high serum calcium is absent but there is always an increased excretion of calcium in the urine.

More and more cases have been detected by investigating, as a routine, every case of renal calculus for evidence of hyperparathyroidism. The renal manifestations may be formation of unilateral or bilateral renal calculi or deposit of calcium phosphate in the renal parenchyma without stone formation. Some patients get recurrent calculi, and in some of them repeated operations have to be done for their removal, before the underlying cause is recognised. The calculi are composed of calcium oxalate, sometimes of calcium phosphate or a mixture of both. Renal colic, haematuria, pyelonephritis, etc., are all known to occur. Sometimes cases have been mistaken for diabetes insipidus because of the polyuria and polydipsia for which the patients may come. Damage to the kidney may occur without the formation of calculi and sometimes signs and symptoms are such that a mistaken diagnosis of chronic nephritis may be made (Hunter, 1938).

Albright has stressed that serious kidney damage may occur in prolonged hyperparathyroidism and may lead directly or indirectly to a fatal issue even after removal of parathyroid tumour. Indeed, renal failure due to nephro-calcinosis or other causes is considered the most lethal of all the complications in hyperparathyroidism. Operations in such advanced cases seem to be of no avail.

The conclusions from all these are :—

1. Hyperparathyroidism is more common than generally supposed;

2. It can occur without any disease of bone;

3. Renal involvement is more frequent and diagnostically more important than osseous involvement.

4. Every patient who has renal calculi should be suspected of having hyperparathyroidism until the contrary is clearly proved or until some other etiologic factor can be clearly demonstrated. (Keating and others, 1945).

Fig. 29 shows skiagram of a vesical calculus and ? metastatic calcification in right ureter in a boy of about 11. Investigations did not confirm either the metastatic calcification in ureter or any evidence of hyperparathyroidism. Nevertheless, this seems to be the type of case which requires a "follow-up" to decide the existence or not of an underlying basis of hyperparathyroidism.

#### BENIGN GIANT-CELLED TUMOUR AND HYPERPARATHYROIDISM

Sometimes patients may have an apparently solitary or localised cyst of bone which may on biopsy appear to be a giant-cell tumour, but further examination may show up the condition to be one of hyperparathyroidism. The other characteristics of hyperparathyroidism may not be obvious and only a routine examination of blood calcium, urine calcium, skiagrams of other bones, etc. may show up the true condition. Sometimes, only the later developments may reveal the true nature. Thus, Goldman and Smyth (1936) report on two interesting cases occurring in a sister and brother. The sister was being treated with X-ray therapy for what was radiologically diagnosed as benign giant-celled tumour. Later, obvious evidences of hyperparathyroidism developed. Parathyroidectomy was followed by a marked improvement. Her brother was being treated for what was thought to be a benign giant-celled tumour (diagnosed by biopsy) with Roentgen therapy, with little or no improvement. There was no clinical evidence of hypotonicity of his skeletal musculature or tenderness

over his bones. Yet, skiagrams showed generalized changes characteristic of hyperparathyroidism. Blood calcium was high. A parathyroid adenoma was found and removed with marked benefit.

#### SECONDARY HYPERPARATHYROIDISM

Hyperplasia of parathyroid glands may occur as a compensatory mechanism resulting from increased physiological demand for the hormone in a variety of conditions (as in multiple myeloma, carcinomatous metastasis to bones, rickets, osteomalacia, and 'Cushing's syndrome'), but is found more especially in chronic renal disease. X-ray examination shows as a rule extensive decalcification of bone structures and often metastatic calcification elsewhere. The parathyroid gland may be markedly hyperplastic but the cells are always of the solid chief type (Cameron, 1947). The blood calcium in secondary hyperplasia is usually normal. Helfet treats these cases of secondary hyperparathyroidism by administration of soluble aluminium salts, the acetate or preferably gluconate and finds some improvement. (Helfet, 1940).

#### THE ROLE OF HYPERPARATHYROIDISM IN VARIOUS OTHER DISEASES

It is interesting to note that attempts are made to associate at least some cases of rheumatoid arthritis, osteitis deformans, etc. with hyperparathyroidism. Convincing proof is lacking. Perhaps there are various stages and types of these diseases and hyperparathyroidism may play a part in some of them. The possibility anyhow is worthy of full investigation and may conceivably form a fruitful subject for research.

It seem worthy of recalling here a case reported on by Col. Bradfield with a pathological report by Dr. A. Vasudevan (Bradfield, 1931), observed in General Hospital, Madras. The boy aged 6 first came under observation in 1913 and had been observed for a period of over 17 years before the case was reported on. He had bizarre deformities and extensive fibrous and cartilagenous changes in the various bones with cyst formation here and there. The skiagrams reproduced fit in, in some respects with hyper-

parathyroidism but in some others they do not fit in with any condition so far described, (such as Albright's syndrome or secondary hyperparathyroidism). Possibly, the case fits in best with a late and inactive or arrested hyperparathyroidism. The possibility of its being more likely a fibrosing form, different from hyperparathyroidism had been commented on then alone by Elmslie.

#### HYPERPARATHYROIDISM FOLLOWING GASTRECTOMY

In the present era, where the vogue is for removing more and more of the stomach for treatment of some cases of peptic ulcers, it is as well to remind one of the far-reaching evil that may occur after gastrectomy. Rarefaction of bones leading to gross deformities of the limbs have occurred in puppies after gastrectomy. Removal of the stomach in growing monkeys cause arrested growth and a condition of the bones resembling osteitis fibrosa cystica, together with hypocalcaemia and enlargement of parathyroid glands. The hypocalcaemia is the result apparently of impaired calcium absorption, due in turn to the absence of hydrochloric acid. (Best and Taylor, 1945).

#### Summary and Conclusions

1. Four cases of hyperparathyroidism, two verified by operation and two others in whom the clinical features suggested the condition but where the adenomata could not be found at operation, are discussed.

2. Hyperparathyroidism is a condition more common than is hitherto recognised. Many cases will be missed, if only the osseous changes are looked upon as the characteristic manifestation of the disease. There are features other than skeletal, which result from hyperparathyroidism of which so-called "renal type of hyperparathyroidism" is the most important, particularly calculous formation. Every case of renal calculus must be systematically investigated for evidence of hyperparathyroidism. Bony changes need not be there. About 10 to 15% of cases of renal lithiasis are due to hyperparathyroidism.

3. Other manifestations of the disease, as for example, general and gastro-intestinal

types, acute type, or marked type, etc. are briefly mentioned.

4. Some conditions of the so-called "secondary hyperparathyroidism", secondary to diseases elsewhere, particularly of the kidneys, are also discussed.

5. There is a suggestion that some cases of osteitis deformans and some types of rheumatoid arthritis may have an underlying basis of hyperparathyroidism. The subject may offer a fruitful field for research work.

6. There is some evidence from experiments on animals that bony changes resembling hyperparathyroidism may follow gastrectomy—a warning against indiscriminate gastrectomy.

7. The girls of 8 and 5 described in cases 2 and 3 seem to be the youngest so far recorded amongst patients suffering from this disease. One other case, 2½ years old has recently been recorded.

8. The various principles in the operation for the removal of a parathyroid adenoma, particularly when an expected adenoma is not found, are discussed.

#### ACKNOWLEDGMENTS:

My thanks are due to the Superintendents of Erskine Hospital, Madura, King George Hospital, Vizagapatam, and Stanley Hospital, Madras, for utilising the records; to Dr. Subramaniam, Erskine Hospital, and to Dr. Daniel, Radiologist, Stanley Hospital, for reprints of skiagrams and clinical photos; to Dr. Govinda Reddy and Dr. G. D. Veliath for pathology reports and to Dr. M. D. Ananthachary for referring case No. 4.

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# SOLID TUMOURS OF THE OVARY WITH A REPORT OF 16 CASES\*.

by K. C. JACOB, Madras.

No organ in the body gives rise to tumours of such varying characteristics as the ovary. The variability of these tumours is markedly noticed in their sizes, clinical features and microscopic appearances. The tumours of the testis, the corresponding male organ, are not so frequent and do not present such diverse pathological features.

Those neoplasms in which the solid component forms a substantial part of the entire mass are designated as solid tumours for purposes of this paper. Such solid tumours of the ovary form only about a third of all ovarian tumours, the rest being mainly cystic. With the increasing knowledge in endocrinology,

mammalian embryology and experimental production of ovarian tumours in mice, there has been a tremendous advance in the understanding of these tumours during the last two decades, making it possible to classify most of them on a histogenetic basis. Table No. I represents the present status of the more important solid tumours, based on Schiller's classification modified by Spencer and Reel.<sup>13</sup>

Table No. II gives the chief features of these neoplasms, ignoring the infrequent types like melanoma, chondroma, etc. There is a good deal of disparity between the statistical data given by various authors, mainly

TABLE I

<i>Ovariogenetic</i> (from the mesenchymal core of the ovary).	(1) From foetal cell remnants without error in sex chromosomes.	(a) Granulosa cell tumour.
	(2) From foetal cell remnants with error in sex chromosomes.	(b) Theca cell tumour. (a) Arrhenoblastoma—male.
	(3) From interstitial tissue without sex potential.	(b) Dysgerminoma—neutral. (a) Fibroma (b) Fibromyoma (c) Sarcoma.
<i>Non-ovariogenetic</i>		
(A) By displacement into the ovary in foetal life.		
early		(1) Teratoma including Struma Ovarii.
late		(1) Mesonephroma? (2) Brenner Tumour (3) Hypernephroma.
(B) By displacement into the ovary in adult life.		
		(1) Metastatic Carcinoma including Krukenberg tumour.
<i>Carcinoma of unknown histo-genesis</i>		Primary Carcinoam

ascribable to the want of uniformity in the nomenclature of these neoplasms.

Recognition of these different types is largely effected by careful microscopic study

and in no other pathological study is it more important to emphasise the value of (a) examining different blocks of tissue from the same tumour, (b) special methods of staining, especially silver-impregnation method,

Serial No.	Type	Incidence Percentage of ovarian tumours.	Age.	Endocrine features	Malignancy	Size.	Bilateral or unilateral.
1.	Primary Solid Carcinoma	About 10%	30-50	..	High	Large sizes.	50% bilateral
2.	Granulosa cell tumour	About 6%	Any age 1-60 years	Feminising	30% malignant	Moderate	10% bilateral
3.	Theca cell tumour	About 1%	After puberty only 40-60	—Do.—	Low	Moderate	Rarely bilateral
4.	Arrhenoblastoma	Very rare	20-35	Masculinising	Low	Moderate	Rarely bilateral
5.	Masculinoblastoma	Very rare	20-40	—Do.—	Benign	Small	Unilateral
6.	Dysgerminoma	About 3%	5-35	..	20% malignant	Usually moderate	Rarely bilateral
7.	Teratoma (including struma ovarii)	About 1.5%	Any age; common in young	..	High	Moderate	Rarely
8.	Mesonephroma	Very rare	Over 45 usually	..	High	Moderate	Unilateral
9.	Metastatic carcinoma (including Krukenberg tumour)	Variable	Advanced ages.		Variable	Moderate	-do-
10.	Brenner tumour	Rare	50% above 50 years. 20-60 years		Benign	Very small and very large	Unilateral
11.	Fibroma	About 2%	After 20 usually		Benign	Mostly small rarely large	bilateral 10%
12.	Sarcoma	Very rare	After 25 usually		High	Moderate	Unilateral



Von Geisan staining, fat and mucicarmine staining.

The 16 cases reported below are from the material examined in this laboratory during roughly the first seven months of this year, 1949. Biopsy specimens are received here mostly from (1) the Government General Hospital, Madras, (2) the Women and Children Hospital, Egmore, Madras, (3) the Kasturba Gandhi Memorial Hospital, Triplicane, Madras, (4) some of the district hospitals in the Madras Province and (5) a few independent medical practitioners. Out of 3,221 biopsy specimens examined during these few months, 97 belonged to ovarian material and the following 16 cases comprise the solid ovarian tumours. The mere fact that these 16 tumours represent 9 different types out of 12 in table No. II is sufficient justification for this paper and reports on these types of tumours in our country are either absent or scarce.

It is also considered necessary to point out to the general surgeon in our country the value of securing pathological reports on all the ovarian tumours they may come across, irrespective of their size or clinical peculiarities. While the gynaecological specialist can be reasonably expected to ask for a pathological report, the general surgeon is apt to throw away ovarian specimens especially when they are not of large size. Even the smallest ovarian tumour may present very important and interesting pathologic features. In America, a co-operative attempt to advance the knowledge in this important field was initiated in 1942 by the formation of a special committee by the American Gynaecological Society to register all ovarian tumours with Novak and other eminent specialists as its members. It would be of great usefulness if every surgeon in our country makes it a point not to discard any ovarian tumour specimen till a definite pathological opinion is obtained. If this is done, much information can be obtained of inestimable value not only from the point of view of reliable statistics, but also from the point of view of helping to give better therapeutic and prognostic opinion with reference to these ill-understood neoplasms.

## Case Reports

### GRANULOSA CELL TUMOUR

**CASE 1: Clinical History:** Suseela, Hindu, female child, aged 3 years, was admitted to the Government Hospital at Guntur, with a history of unusually early menstrual periods and a gradually increasing swelling in the abdomen. It was ascertained that she was menstruating once in one or two months during the previous eight months, the quantity of blood being scanty and varying from time to time. Physical examination revealed the presence of fairly well-developed breasts, pubic hair and a pelvic tumour. At operation, a large-sized tumour from the right ovary was removed, the other pelvic and abdominal viscera showing no definite pathological change. Nothing has been heard about her condition after the operation.

**Pathological Report: Gross:** The specimen consists of a solid 'giant ovary', 17 x 14 x 9 cms. and weighing 1,200 gms. (Fig. 1). A stretched fibrous capsule covers the entire tumour. The sectioned surface bulges markedly presenting soft grayish tissue with areas of necrosis and yellowish streaks and specks. No portion of the ovary could be recognised. Cystic spaces with loose necrosed contents and one or two other small cysts without any solid contents or signs of degeneration are present.

**Microscopic:** The general pattern presents the picture of the 'diffuse' type, consisting of granu-



Fig. 1.  
Granulosa cell tumour. (Case No. 1.)

losa cells with no suggestion of folliculoid arrangement (Fig. 2). The cells are more or less uniform in size and shape; but placed in different directions in the same field. Stroma is very scanty. A few mitotic figures are present. Extensive areas of necrosis are noticed. The capsule consists of a uniform layer of fibrous tissue and there is no evidence of stretched ovarian tissue in the examined sections.



Fig. 2.

Granulosa cell tumour. (Case No. 1.)

**CASE 2: Clinical History:** Shenfa Bee, Muslim, female, aged 19 years, was in the Government Hospital at Coimbatore, with a tumour in the abdomen of six months' duration. She was an unmarried woman with regular and normal menstrual periods. Laparotomy revealed a partly solid and partly cystic tumour involving the right ovary, extending up to midway between the umbilicus and the costal margin. Other viscera appeared normal. She had an uneventful post-operative course and was not seen since her discharge from the hospital.

**Pathological Report:** Gross: Specimen received here comprises two oval shaped solid tumour bits 2 x 1 cm., soft in consistency, grayish in colour with yellowish and reddish discolouration in places.—No cystic spaces.

**Microscopic:** A uniform sarcomatous pattern, is observed with areas of oedema, necrosis and haemorrhage. Oedematous fibrous stroma separates columns of the tumour cells in places.

#### Comment:

Both of these cases are examples of granulosa cell tumours occurring in young individuals. It is said that only about 5% of the tumours appear under the age of 20 and the incidence before puberty is very small. Gross<sup>8</sup> states that there are 11 case reports of patients under 10 years and reports one occurring at 13 months. Bland and Goldstein<sup>2</sup> reported a tumour in a child of 7 years with precocious menstruation which was relieved by the removal of the tumour; but which recurred when a second tumour developed in the opposite ovary. Southam's<sup>12</sup> patient of 2 years and 10 months had vaginal bleeding, enlarged breasts and growth of pubic hair. Lull<sup>8</sup> reports a case in a child of 9 months of age, which is the youngest on record. These tumours may occur at any age and the special symptoms depend on the effect of the oestrogenic hormone at that particular age period. The maximum incidence is during the reproductive period and since there is already the hormone acting on the individual, striking clinical abnormalities may not be observed. In the post-menstrual group, the tumour produces a re-establishment of periodic menstruation like bleeding and also a hypertrophy of the uterus without any effect on the secondary sexual characters. But in children, long before the inauguration of the normal oestrogenic function of the ovary, precocious puberty sets in with its characteristic clinical features. Case 1 is a good example of precocious puberty caused by granulosa cell tumour, the menstruation having started when she was about 2 years and 4 months old, while the patient in case 2 being in the reproductive period did not complain of any menstrual irregularity.

#### MESONEPHROMA

**CASE 3: Clinical History:** Chintha. Hindu, female, aged 45 years, was admitted on 16th February 1949 to the Women and Children Hospital at Calicut for pain and swelling in the abdomen of 2 years' duration. She had been married for 34 years; but had never been pregnant. Menopause set in 12 years ago. Physical examination showed the presence of a tumour extending from the pelvis to the costal margin. At operation on 26th February 1949, a large tumour was removed from the right ovary and multiple small fibroids were seen in the uterus. She was discharged 21 days later,

**Pathological Report: Gross:** Only three pieces of the tumour were received here for examination. These are solid and hard in consistency with no cysts detectable even with a magnifying lens.



Fig. 3.  
Mesonephroma. (Case No. 3.)

**Microscopic:** A number of small cystic spaces lined by a single layer of epithelium are found embedded among bundles of fibrous tissue running in various directions (Fig. 3). The lining cells are broader than they are high, have very little cytoplasm and the nuclei are prominent and protruding—the hobnail or mushroom shaped cells. Papillary projections into the cysts simulating a glomerulus in shape are occasionally seen; but there is no structural resemblance between the two. Generally, the epithelium is low cuboidal and the spaces are mostly round or oval-shaped.

#### Comment

The age incidence of this type of tumour is interesting. For the entire group of 15 patients studied by Jones et al<sup>5</sup>, the average age was 51, with extremes of 41 and 72 years. Jones considers this a malignant tumour, with no special symptoms thereby making it impossible to arrive at a pre-operative diagnosis. The origin of the tumour is still in dispute. The mesonephric origin suggested by Schiller has not been accepted by many pathologists. Angioendotheliomatous derivation proposed by Kazancigal et al<sup>6</sup> has

also no substantial support. Jones et al considers it of epithelial origin and comprising a definite pathologic entity. Whether it is an atypical form of carcinoma of the ovary or not can only be answered by more detailed clinical and pathological study of this group of tumours. Gunner Teilen<sup>14</sup> considers this type of tumour as an intermediate form (Gonocytoma II) between the dysgerminoma and the chorion epithelioma groups and cites some cases illustrating corresponding homologous tumours in the testis.

#### DYSGERMINOMA

**CASE 4: Clinical History:** Kathaye, Hindu, female, 20 years, sought admission to Kasturba Gandhi Memorial Hospital, Triplicane, for a swelling in her abdomen with irregular bleeding per vaginum during the last 10 months. She was married 6 years ago, and had two children, the last one being 1 year old. On opening the abdomen, a large quantity of free fluid was found in the peritoneal cavity, with a tumour arising from the left ovary. She was discharged in a satisfactory condition after the usual post-operative period.

**Pathological Report: Gross:** The specimen is an ovoid tumour 12 x 9 x 8 cms. and weighing 450 gms. covered over by a capsule which had been broken through in one place, well protected by adherent omentum. There is slight nodular irregularity of the surface; soft in consistency with a doughy feel. The sectioned surface shows gray, yellow and reddish areas with extensive necrosis. Naked eye cysts are absent.

**Microscopic:** The section shows the usual typical pattern of large round or polygonal cells arranged in alveoli separated by fibrous tissue septa which show lymphocytic infiltration (Fig. 4). Necrosis, degeneration and haemorrhage are seen in places.

**CASE 5: Clinical History:** Dharmi, Hindu, female, aged 18 years, was admitted to Dr. Sundaravadanam's nursing home for a growing tumour in the abdomen of one year's duration. Her father had died of carcinoma of the tonsils. About 6 months before admission, she developed severe pain in the abdomen with temperature and was treated for tuberculous abdomen with 120 gms. of streptomycin. Later, she had bronchopneumonia. Her menstruation started when she was 12 years of age, and was normal and regular since then. At operation, a large tumour involving the right ovary, occupying the pelvis and lower half of the abdomen was seen, other viscera being normal. The tumour had a pedicle and was easily removed, there being no adhesions. During the post-operative period, she had a slight lung affection with raised temperature. Since her discharge from the hospital, she is said to be quite normal, excepting for an occasional rise of temperature to 99°.



Fig. 4.  
Dysgerminoma, (Case No. 4.)

**Pathological Report:** Gross: Only three small pieces of the tumour are available for examination. Smooth capsule is present and the tumour tissue is soft in consistency and slightly friable.

**Microscopic:** Histological picture conforms to the usual pattern of dysgerminoma.

#### Comment

The above two patients are young individuals, as is the usual history of dysgerminomas, only about 10% being met with in women past the age of 40 years. About 35% of the cases are under 20 years; but very young children are not affected, the youngest case mentioned by Novak<sup>9</sup> being 6 years old. Although no sexual abnormalities exist in half the cases, the other half is associated with sexual underdevelopment or hermaphroditism, pseudo or real. The tumour has nothing to do with the development of the sexual abnormality. It is interesting that the right side is more often affected, while both sides may be affected in about 35% of cases.

The histogenesis remains obscure. The favourite view is Meyer's that the tumours arise from 'indifferent germ cells.' The early

age incidence, the significantly frequent association with pseudohermaphroditism and the preference for the right ovary suggest a relationship to some developmental disturbance. Whether the tumours are indeed seminomas derived from persistent male tissue in an indifferent bisexual gland is uncertain, but not improbable (Willis):

Taken as a group they are less malignant than the granulosa cell tumours but more malignant than the arrhenoblastomas. Testicular seminomas are more malignant than the corresponding dysgerminomas, probably due to the endocrine differences. Microscopical appearances cannot be depended upon for the estimation of malignancy and hence the gross findings at the time of the operation will have to be used as a workable criterion. Well-encapsulated cases offer a good prognosis, while those with invasion of the surrounding peritoneum are less favourable and those with metastases certainly most unfavourable. Russo & Kelso<sup>10</sup> report a case in a woman of 48 years with 10 healthy children, with extension of the tumour to the peritoneum and surrounding tissues surviving 7 years with X-ray treatment and male sex hormone therapy.

#### TERATOMA INCLUDING STRUMA OVARI

**CASE 6; Clinical history:** Thayaramma, Hindu, female, 45 years, was admitted to the Kasturba Gandhi Memorial Hospital, Triplicane, with a complaint of pain and swelling in the lower abdomen. Periods were regular till she attained menopause about 10 years ago. Four children were born and no abortions. B.P. 130/90, pulse 80 per minute, Hb. 45%. At the time of the operation, the tubes, uterus and the other ovary were found healthy and the tumour arising from the right ovary was excised. There was no enlargement of the thyroid, neither was there any evidence of hyperthyroidism. The patient was discharged after an uneventful post-operative course and has not been seen afterwards.

**Pathological report:** Gross: Only a portion of the original tumour, about 2 x 1 x 1 cm. was received here. The cut surface presents small cystic spaces with colloid-like material inside and the major part of the tissue resembles grossly a foetal adenoma of the thyroid gland.

**Microscopic:** The picture is that of an adenoma of the thyroid (Fig. 5). Acini of varying sizes containing deep acidophilic colloid material are seen. Areas of adenomatous proliferation without formation of acini are also noticed. Vacuolation and scalloping are present. Careful examination of several sections reveal the

presence of a few mucous glands, a bit of cartilage and a duct wall lined by stratified columnar epithelium.

**CASE 7: Clinical history:** Ranganayeku, Hindu, female, 22 years. was admitted to the Government Hospital, Ellore, with a history of 7 months' amenorrhoea. She had no children or abortions previously; but had missed her periods for 3

animity of opinion about the histogenesis of these tumours. Willis<sup>15</sup> considers them as arising from foci of plastic pluripotential embryonic tissue which escaped from the influence of the primary organizer during early embryonic development.



Fig. 5.  
Struma Ovarii. (Case No. 6.)

months once before about 4 years ago. Palpation showed a hard tumour about the size of 7 months' pregnancy, irregular in shape and fixed. She had a moderate rise of temperature from the date of admission and leucocytosis was detected. On opening the abdomen, clear sanguinous fluid was present and the tumour arising from the right ovary was easily excised. She developed acute pain in the chest and dyspnoea, three days after the operation which responded to symptomatic treatment.

**Pathological report: Gross:** Only a small piece of solid tumour is available for examination.

**Microscopic:** It is a jumbling up of several kinds of tissues (Fig. 6). The most prominent elements are cystic spaces lined by (1) stratified squamous epithelium, (2) stratified ciliated columnar epithelium, (3) tall columnar epithelium, (4) cuboidal epithelium and cartilage plates. Glandular formation is in evidence. Young nervous tissue, ganglion cells, fat spaces, fibrous tissue, nonstriated muscle fibres are also noticeable. There is no histological evidence of malignant change.

#### Comment

Solid teratoma is far less common than the cystic 'dermoid.' There is still no un-



Fig. 6.  
Teratoma. (Case No. 7.)

In some of these tumours, one of the elements overgrows and finally almost blots out the other tissue elements. The term 'struma ovarii' is given to such a tumour with a large proportion of thyroid tissue. Microscopic detection of thyroid tissue elements is possible in about 20% of cases of teratoma after very diligent and laborious search; but tumours with a large proportion of thyroid tissue are comparatively rare. The term 'pure struma ovarii' is applied to tumours where other tissue elements are not seen. However, many of these, after several examinations of different blocks of tissue, are likely to show some other foreign element, as in the case reported by Heller et al.<sup>4</sup> Clinical assaying and biological experiments have affirmed the true thyroid nature of the tissue in some of the reported cases and in 5% of cases a state of hyperthyroidism was co-existing. It is not known why this one-

sided overgrowth takes place in the teratomas at the expense of the other component elements.

#### THECA CELL TUMOUR

**CASE 8: Clinical history:** Mrs. Parvathi, Hindu, female, 56 years, got admitted to the Kasturba Gandhi Memorial Hospital, Triplicane, with a history of swelling of the lower abdomen gradually increasing in size for one year. She had one full-term child and three abortions, the last one being 12 years back. Menopause set in 10 years ago.

**Pathological report:** Gross: The specimen is a firm, irregularly nodular lobulated solid tumour from the right ovary measuring 16 x 13 x 11 cms. and weighing 690 gms. (Fig. 7). A few cystic spaces are seen, both on the sur-



Fig. 7.

Theca cell tumour. (Case No. 8.)

face as well as on the cut surface, the largest being about 2 cms. in diameter. Sectioned surface presents somewhat of a whorled appearance with dull orange yellowish streaks and areas, here and there. Consistency is firm in some areas while more softish in others. A small bit of ovary is found attached to the main tumour mass. The capsule is thin and glistening and not broken through anywhere.

**Microscopic:** Bands of large spindle-shaped cells are seen in an intertwining pattern (Fig. 8). A few fibrous bands and hyalinised fibrous tissue are found in between. Typical granulosa cells are

not detected. Reticulum stain shows abundance of fibres formed by the tumour cells and frozen sections reveal the presence of intra- and extracellular fat staining particles.

#### Comment

Differential diagnosis between fibromas, fibromyomas and theca cell tumours is not always easy. In this case a broad ligament fibromyoma was excluded by the gross features and differential staining characteristics. The general impression is that theca cell tumours are not very large in size; but Knight<sup>7</sup> reports a case where the tumour measured 30 x 24 x 14 cms. and weighed



Fig. 8.

Theca cell tumour. (Case No. 8.)

7727 gms., arising from the left ovary which was part of the tumour and was suspended by a pedicle. Small tumours of 3 m.m. diameter have also been reported (Banner & Dockerty). The age incidence is interesting. In the literature, theca cell tumours have not been reported as occurring prior to the age of puberty. The average age of patients in a collection of 23 cases was 54 years.

Irregular vaginal bleeding of the post-menstrual type or gross menstrual irregular-



rity of younger patients existed in more than 60% of reviewed cases (Banner & Dockerty). Only four out of 23 did not exhibit any menstrual aberrations in this series; this is probably explained by the total amount of functioning active tissue in the tumour depending on the degree of maturity and senescence attained by the component cells. The absence of granulosa cells in the above reported case is also significant in explaining the absence of any hormonal effects.

#### PRIMARY CARCINOMA

**CASE 9: Clinical history:** Margathamma, Hindu, female, 42 years, was admitted to the Women and Children Hospital, Egmore, for a tumour in the abdomen of one year's duration. She had 8 abortions and 8 full-term children, the last being 7 years old. For the past 8 years her periods were scanty though regular. On physical examination, there was a large irregular mass filling the lower abdomen, tender and dull on percussion. P.V. a large soft tumour bulging into all the fornices pushing the uterus to the right pointing to a pre-operative diagnosis of ovarian tumour. The abdomen was opened and a tense ovarian tumour on left side was removed after severing a few adhesions. Two ounces of yellowish fluid were present in the peritoneal cavity. The fresh specimen was described as partly solid and partly cystic with sebaceous-like material from the solid area.

**Pathological report:** Gross: Only three small pieces of the tumour were received here, soft and mostly solid in appearance.

**Microscopic:** Appearances are of medullary carcinoma with a number of mitotic figures.

**CASE 10: Clinical history:** Gowri, Hindu, female, 40 years, was admitted to the Women's Hospital at Mangalore for pain and swelling of the lower abdomen, of 6 months' duration. Menstrual periods used to be regular, lasting about 5-6 days each time, prior to the past 6 months, since when the flow has been scanty, lasting only 2 days at a time. A tumour of about the size of a 28 weeks' pregnancy, movable and not tender, was felt on physical examination. On laparotomy, a partly solid and partly cystic growth from the left ovary adherent to coils of intestine and eroding into the pelvic colon was seen. The mass was removed in pieces and was haemorrhagic and friable.

**Pathological report:** Gross: Two solid pieces of soft, greyish tumour with haemorrhagic areas were received here.

**Microscopic:** The structure is that of an alveolar carcinoma with areas of necrosis and haemorrhage (Fig. 9). Many dark staining cells with mitotic figures are present.

**CASE 11: Clinical history:** Mangalam, Hindu, female, aged 53 years, complained of irregular bleeding for 6 months, when she was admitted to the Kasturiba Gandhi Memorial Hospital at Tri-

plicane, Madras. She underwent an operation 2 years ago at Madura for a growth of the left ovary, and subsequently she had amenorrhoea for 1½ years. At operation, the growth was from the right ovary, the other viscera showing nothing specially abnormal.



Fig. 9.  
Primary Carcinoma; (Case No. 10.)

**Pathological report:** Gross: The specimen measures 5 x 3 x 3 cms, is oval, slightly irregular on the outer surface and is covered over by a stretched capsule—slightly firm in consistency. Greyish white solid areas with a few small cystic spaces characterize the sectioned tumour.

**Microscopic:** The section is a typical papillary adenocarcinoma.

**CASE 12: Clinical history:** Seshamma, Hindu, female, aged 50 years, sought admission to the Government Hospital at Masulipatam for a lump in the lower abdomen gradually growing in size for 9 months and causing pain. She was never pregnant, her periods were regular till her 35th year, then there was menorrhagia for 5 years followed by menopause. Growth from right ovary was excised at operation.

**Pathological report:** Gross: Only small bits available for examination. These are solid and firm with a few cystic spaces.

**Microscopic:** The section consists essentially of a number of tubular spaces lined by epithelium, in some places with papillary projections and in others infiltrating the stroma in groups of cells. Some fields suggest a resemblance to the pattern of mesonephroma.

**CASE 13:** *Clinical history:* J. Veeramma, Hindu, female, 40 years, was admitted to the Government Hospital at Guntur with a history of tumour in the abdomen of 2 months' duration. Her menstrual periods were regular till 4 months back, after which there was no bleeding. She had two children, the last being 16 years old. The operation consisted of removal of ovarian tumours from both the sides, the left being bigger and also appendicectomy. There was no free fluid in the abdominal cavity and the other viscera were normal.

*Pathological report:* Gross: The tumour of the left ovary measures  $11 \times 9 \times 5$  cms. and weighs 200 gms. (Fig. 10). It is irregularly nodular and assumes a distorted kidney shape. The fimbriated end of the tube is seen attached to the tumour. The sectioned surface is yellowish grey with one or two cystic spaces filled with loose necrotic tissue. Coarse bands of fibrous tissues are seen traversing between the greyish tumour masses.

*Microscopic:* Anaplastic carcinomatous cells form the major part, with a few areas showing a papillary adenocarcinomatous pattern. (Fig 11). Fibrous tissue stroma in large bands separate the epithelial cell groups.

The tumour of the right side is smaller.  $10 \times 5\frac{1}{2} \times 2$  cms. and weighs 90 gms., but otherwise similar to the contra-lateral growth. The section on microscopic examination shows stretched ovarian tissue in addition.



Fig. 10.

Primary Carcinoma. Cut surface of tumour left ovary and outer surface of tumour right ovary. (Case No. 13.)

### Comment

This group includes the carcinomatous tumours of the ovary when they do not conform to any of the special types mentioned above and when they do not appear histologically or clinically to be secondary to some primary growth elsewhere. There is no unanimity of opinion regarding the subdivision of this group into special types as suggested by Novak<sup>9</sup> etc. Case 12 showed histological similarity to mesonephroma in certain places; but some of the appearances do not seem to justify it to be placed in that category. Schiller thinks that they are derived by malignant change of benign neoplasms of the ovary.

### SECONDARY CARCINOMAS INCLUDING KRUKENBERG TUMOUR

**CASE 14:** *Clinical history:* Veerayamma, Hindu, female, aged 40 years, went to the Government Hospital at Salm for pain and discomfort in the abdomen for one month. She gave a typical history of gastric ulcer for 10 years. She had 4 children, the last was born ten years ago. She had amenorrhea for one month and complained of excruciating pain for 3 days. At operation there was a cancerous growth at the pyloric end of the stomach with secondary deposits in both the



Fig. 11.

(Primary Carcinoma. Case No. 18.)



ovaries, tubes and peritoneum. Free fluid was present. The liver appeared healthy. She was discharged with a healed scar, 12 days after the operation.

*Pathological report: Gross:* Only small bits of the ovary and one tube were received here.

*Microscopic:* Infiltration of the ovary with mucus secreting carcinomatous cells are seen (Fig. 12). In places, tubules lined by columnar epithelium are present. Many signet ring cells in a fibromyxomatous stroma form the main picture.

#### Comment

Ovaries are frequently the seat of secondary deposits from (1) various forms of pelvic carcinoma and (2) carcinoma of the gastro-intestinal canal especially of the pylorus. The latter is more frequent. The term Krukenberg tumour is usually limited to firm solid growth of moderate size, bilateral mostly, retaining the general shape of the ovary and showing microscopically epithelial elements exhibiting mucoid change in the form of signet cells. The ovarian involvement is explained by three hypotheses: (1) peritoneal sedimentation, (2) lymphatic permeation and (3) blood vascular spread. The important point for the surgeon is to investi-

gate the conditions within the upper part of the abdomen when confronted with bilateral solid lobulated ovarian tumours.

#### FIBROMA

*CASE 15: Clinical history:* Seethammal, Hindu, female, aged 29 years, on admission to the Government Hospital at Madura, complained of a tumour in the abdomen of 6 months' duration. A freely mobile, tense tumour of the size of a cocoanut was felt on examination. She went away against medical advice but was readmitted soon. Periods were regular, had three children, the last 3½ years old. A solid pedunculated freely movable growth was removed by operation. Moderate fluid was present in the abdominal cavity. Renal glycosuria was detected.

*Pathological report: Gross:* The specimen received is a small piece of solid tumour, whitish in colour and firm in consistency.

*Microscopic:* It consists of small fusiform or stellate cells with a large quantity of intercellular wavy substance (Fig. 13). There is no evidence of mitotic activity; and no epithelial derivatives.

#### Comment

This is the commonest of the benign solid tumours of the ovary and at times reaches very large size though the majority of them are small polypoid growths or whitish cir-

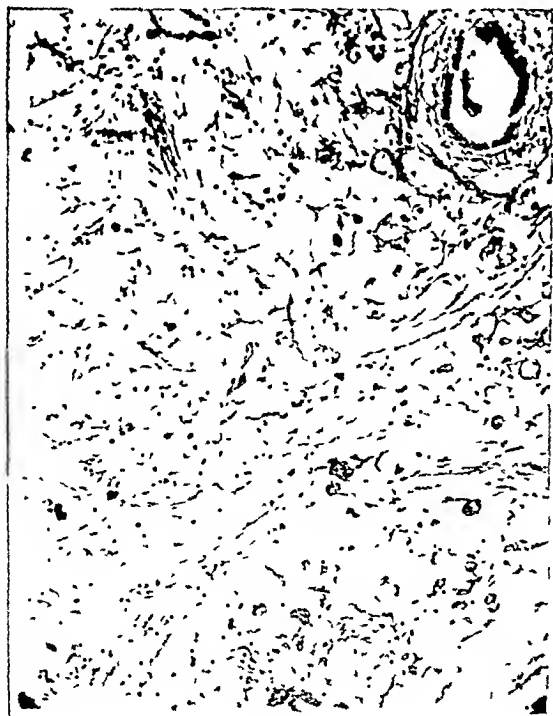


Fig. 12.  
Secondary Carcinoma. (Case No 14)

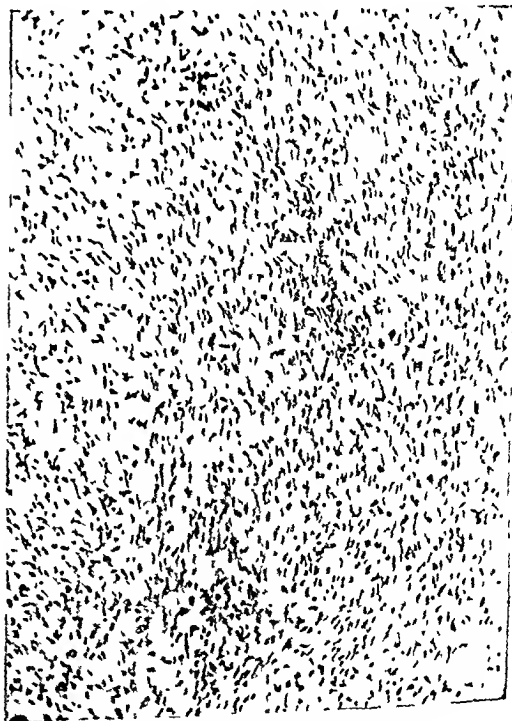


Fig. 13.  
Fibroma (Case No. 15.)

cumscribed nodules in the substance of the ovary. Meig's syndrome of hydrothorax with ascites has been first described in relation to fibromas of the ovary; but now the same phenomenon has been observed with other tumours like Brenner tumour, granulosa cell tumour, etc.

According to Coe, fibroma represents an overgrowth of the ovarian cortical stroma while Brothes believes this overgrowth to be in the nature of a keloid response to haemorrhage within the ovary (quoted by Dockerty). It is presumed that these originate from the fibrous tissue elements of the ovary. Novak<sup>9</sup> considers that at least a fraction of these are undoubtedly secondary to Brenner tumours while Willis<sup>15</sup> affirms that dense fibromas are the end product of the Granulosa cell, theca cell series.

### SARCOMA

CASE 16: *Clinical history*: Muttammal, Hindu, female 35 years, was operated upon at the Government Hospital, Madura, of a slowly growing tumour of the ovary. The growth was lobulated and cystic in places and there was free fluid in the peritoneal cavity.

*Pathological report*: Gross: Several small pieces of friable, grayish solid material were received here.

*Microscopic*: Appearances of a spindle cell sarcoma with a number of hyperchromatic and irregular and giant nuclei. It resembles a fibromyosarcoma in places; but no part of the sections examined shows definite evidence of origin from benign fibromyoma (Fig. 14).

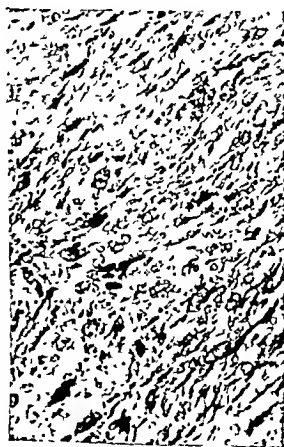


Fig. 14.  
Sarcoma, (Case No. 16.)

### Comment

Most of the sarcomas, if not all, are derived from malignant change of benign precursors. Barzilai was able to find only 3 cases of primary sarcomas in a collection of 10,000 ovarian specimens (quoted by Spencer & Reel).

### Summary

(1) 16 cases of solid ovarian tumours are briefly reported from the material received in this department during roughly the first seven months of 1949.

(2) Tables are given to represent the histogenesis and chief characters of these neoplasms.

(3) A plea is made to preserve every excised growth in the ovary for pathological examination.

### Acknowledgments:

I am thankful to the various medical officers for furnishing the clinical history concerning the specimens sent to this laboratory.

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# ILEO-COLIC TUBERCULOSIS

by Dr. C. P. V. MENON & Dr. (Miss) ANGULI, Madras

## Part I

This paper is a study of the clinical, pathological and experimental aspects of enterocolic tuberculosis and non-specific ulceration of the intestines. An endeavour is also made to correlate the clinical and pathological findings and to compare them with experimental evidence.

The work has been pursued on the following lines:

1. Collection of clinical data, with a view to define the clinical complex of the disease, from the cases admitted in the Government General Hospital, Madras, during 1946-1948.
2. Laboratory study:
  - (a) Motion examination,
  - (b) Sputum examination,
  - (c) Resting gastric juice,
  - (d) Fractional test meal,
  - (e) Haematological examination,
  - (f) Biochemical estimations,
  - (g) Roentgenological studies and
  - (h) Routine urine examination.
3. Choice of treatment and close follow up of the cases.
4. Pathological study of the specimens.
5. Bacteriological investigation of the specimens:
  - (a) Demonstration of the organism in the lesion and
  - (b) Isolation of the organism through culture and animal inoculation.
6. Animal experimentation.
7. Study of statistics.

A total of 365 cases were admitted into the Government General Hospital, Madras, as cases of intestinal tuberculosis during the decennium 1939-1948, out of which 125 were surgically treated. Out of this number, 125, as many as 76 were histologically proved to be tuberculous. The cases with symptoms

of intestinal tuberculosis admitted into the hospital during the last two years were 102, which included a number of cases of non-specific ulceration. The diagnosis was based upon clinical and operative findings, laboratory investigations and radiological evidence.

In this series, the youngest patient was 13 years old and the oldest was 51 years old. The average age was 29 years. The duration of the disease varied from 3 weeks to 10 years, the average duration being 3 years. (The clinical manifestations of intestinal tuberculosis might be mild for months or years and the involvement may be widespread and of long duration.) The ratio of females to males was about 3 : 2. The patients who had advanced pulmonary tuberculosis in addition numbered 21. They were referred to sanatoria and their subsequent course was not known. A complete follow-up was possible only in 44 of the cases treated surgically.

## Clinical and Laboratory Study of the 44 Cases

The predominant presenting complaint in this group of individuals was abdominal pain, usually intermittent in character, colicky in nature and often localised to the right lower quadrant and the peri-umbilical region. It was of the vague generalised type in certain cases. When the lesion was situated high up in the jejunum or proximal ileum, the pain was periodical and was related to food as in duodenal ulcer. The second most common symptom was loss of weight.

Diarrhoea and intermittent constipation were noted only in a few. Vomiting occurred in only 7 cases. Discharging abdominal sinuses were found in one case. Two cases came with symptoms of acute intestinal obstruction and were treated as emergencies. One was perforation with peritonitis (case I) and the other was ileo-caecal intussusception (case II). Irregular moderate afternoon rise of temperature, associated with mild degree of toxæmia, was

present in many of the cases. Signs of *nutritional deficiency* were present. A *palpable tumour* in the ileo-caecal region was present in 60% of the cases. *Visible peristalsis* was noted in a few, and in them *tense sausage shaped tumours* were occasionally palpable around the umbilical region.

### Laboratory Investigations:

*Anaemia*—50% showed *hypochromic anemia*.

*Leucocytic count*—The count was normal in the majority of the cases. *Leucopenia* was noticed in a few. The differential count showed *lymphocytosis* with a slight increase in the *eosinophiles*. *Blood sedimentation rate* was markedly increased in the majority of the cases.

*Blood chemistry*: It was interesting to note that the lowered serum calcium level returned to normal after radical resection of affected segment, whereas it remained at the low level in cases when the first stage short circuiting procedure alone was carried out. The serum protein values were low in the majority but the return to normal after the radical surgical operation was rather more delayed than in the case of calcium.

*Faeces*: Nearly 50% showed infestation with *ascariasis* and perhaps, this accounted for the relative *eosinophilia*. *Occult blood* was present in a few instances.

*Sputum* was examined for acid fast organisms, with negative results.

*Resting gastric juice*—Acid fast bacilli were found in two instances, only. The patients had pulmonary lesions which showed progressive improvement after radical surgery.

*Fractional test meal*—Both free and total hydrochloric acid were absent in one-third of the cases.

*Roentgenological manifestations*—X-ray studies afforded the only means of confirming the clinical diagnosis. The roentgen signs of diagnostic value were:

- (1) Failure of caecum and the ascending colon to retain the barium in a Barium meal series (Stierlin's sign)  
—(Fig. 1.)



Fig. 1.

Barium M—The caecum and the ascending colon not visualised—Sterlein's sign. Terminal coils of ileum dilated.



Fig. 2.

Barium Enema—Filling defect of the caecum giving rise to the shrivelled appearance.

- (2) Presence of spasm or filling defects, irregularities in contour and absence of haustrations. The filling defect was irregular in outline and corrugated in appearance, giving rise to a longitudinal shrivelling of the caecum (Fig. 2).
- (3) Dilatation of the ileal loops.
- (4) Undue delay in the emptying of barium in the ileal loops, and sometimes of that in the stomach.

- (5) A widening of the shadow of the barium in the terminal ileum without the normal pointed appearance in a barium meal or, regurgitation of barium into the ileum during a barium enema, administered under ordinary pressure (Fleishner's sign) (Fig. 3).



Fig. 3.

Barium Enema—Irregular filling of the caecum with a thin irregular streak of barium seen in it. Barium seen in the small intestine. (Fleishner's sign).



Fig. 4.

Multiple fluid levels in a case of intestinal tuberculosis with strictures.

- (6) Multiple fluid levels in the small gut due to multiple strictures was noticed in one case (Fig. 4).

Pulmonary lesions were found in 11 cases, radiologically. Skiagrams could not be taken in a few, but the clinical examination did not reveal any pulmonary pathology.

It was previously thought that intestinal tuberculosis was rare unless there was a pre-existing pulmonary disease. In this series 19 cases had tuberculosis of the bowel without any clinical or radiological evidence of primary lesions elsewhere in the body.

### Observations on Surgical Procedure

Surgical resections of the involved portion with the object of eradicating the focus was followed in this series. This radical attitude was justified on the evidence of the rapid onset of a bright clinical state soon after such a procedure. When such an infected focus was removed, the resistance of the individual to fight the remaining disease process, if present, was increased. One had to witness the temperature touching normal and the toxæmia disappearing in a few days after the operation, to appreciate and follow the radical surgical measures advocated in such cases (case 3).

It was surprising to note that limited pulmonary lesions improve progressively after radical surgical intervention on the gut (case 4).

Death due to progressive fulminating toxæmia and to failure of liver function terminating in jaundice a few days after the operation was witnessed in three instances as for example in Case (case 5).

### Observations on Gross Pathology

The peritoneum, spleen and liver were remarkably free from tubercles. The liver showed varying degrees of fatty change. The greatest incidence of intestinal tuberculosis was found in the caecum, and next in the order of frequency in the ileum and colon. Rokinstansky stated that the tubercles occurred primarily in the domain of the lymphoid tissue, and the abundance of this tissue in the ileo-caecal region accounts for the predilection of tuberculosis for that region.

Stasis for a considerable time in this region had been advanced as an argument for this predilection.



Fig. 5.

Tuberculosis of the small intestine with strictures and mesenteric tuberculous lymphadenitis.



Fig. 6.

Tuberculosis of the small intestine with strictures laid open.

Extensive involvement of the jejunum and the ileum with almost absolute freedom of involvement of the terminal ileum was observed in a few cases—Fig. 5. The intensity of the infection was noticed in the proximal ileum and as the distal portion of the ileum was reached, the lesions were few and far apart, the terminal 1 to 2 feet looking normal. Stricture formation and dilatation

of the segment of the bowel in between strictures were observed in these cases—Fig. 6. The mesenteric lymph nodes draining the terminal ileum in these cases showed evidence of tuberculous infection, while there was no ulceration of the gut. In the absence of any demonstrable focus elsewhere in the body, it is suggested that this type of lesion could be designated "the primary intestinal complex."

The occurrence of the mesenteric node tuberculosis with no intestinal ulcers could be considered as the primary complex—this being consistent with our present concept of the manner of infection of the intestines by the *Mycobacterium tuberculosis*. It is now believed that the primary lesions occur in the lymphatics and lymph nodes and that the ulceration of the gut is secondary (Taylor 1945). The freedom from ulceration of the terminal ileum in the primary type is consistent with this view. In the intestinal lesions secondary to pulmonary disease, the terminal ileum which is rich in lymphatics acquires an allergic state and is the first portion of the intestine to ulcerate. Fig. 7



Fig. 7.

Terminal ileum free from ulceration; local lymph nodes showed tuberculous reaction.

Another interesting observation was regarding the location and distribution of the mesenteric fat. In cases where the resected gut was of a non-specific nature, the serosal surface of the affected segment was almost entirely obscured by the extension of the mesenteric fat.

Attention has to be drawn to the fact that it is impossible on a basis of clinical features or morbid anatomy to distinguish between hyperplastic enterocolic tuberculous and non-specific enterocolitis—Fig. 8. There were two instances in which the condition was mistaken to be malignant, but proved to be due to tuberculosis histologically. There was a single case in which the caecum was the seat of an adenocarcinomatous process in addition to a tuberculous infection; in this case the malignancy was not suspected on the operation table—Case 4.



Fig. 8.

Tuberculosis of the ileo-caecal region with multiple strictures simulating cicatrizing non-specific ulceration.

Case 1 is an instance to show that in tuberculosis, the lesions at the proximal segments are more advanced (in age) than those in the distal segments. Perforation of a tuberculous ulceration is a rare event and if it happens, it is usually in the proximal ileum in contra-distinction to typhoid perforation which is in the terminal ileum.

### Operative Technique:

The general preoperative measures required for any major surgical procedure were carried out, including routine blood grouping and matching. Phthallyl sulphathiozole, 1

gramme—every four hours was given for a week.

The operations were done under spinal, general or local anaesthesia—depending upon the general condition of the patient. The operations lasted for 1½-2 hours. I.V. glucose saline followed by blood transfusion was employed whenever necessary to combat shock.

Enterocolic tuberculosis was treated by right hemicolectomy. The parts removed in the resection were the last 6" of the ileum, the caecum, ascending colon, hepatic flexure and the proximal 1/6 of the transverse colon



Fig. 9.

Ileo-caecal tuberculosis with adeno-carcinoma of the caecum.

with a wedge of the mesentery containing the affected lymph nodes. Where the ileum was affected, the involved segment was included in the resection. (Fig. 9.)

A right paramedian incision was used. The extent of the involvement was noted. (The degree of resectability had been high in this series of cases). A one stage operation was preferred in most instances except where the patient was unfit or the caecum was very fixed—when a two stage procedure was considered, the actual resection being carried out at a later stage, through an oblique muscle cutting incision in the right iliac fossa.



Fig. 9a.

*Right*—Adeno-carcinoma and collections of epithelioid cells.

The caecum and the ascending colon were mobilised with their blood and lymph supply; the outer leaf of the peritoneum, which is practically devoid of blood vessels was incised—(Fig. 10) and the entire segment was turned medialwards by careful gauze dissection. The spermatic vessels, the vas and the ureter came in succession as the dissection was carried from below upwards. The hepatic flexure was freed by blunt dissection and turned downwards and medially. Elevation of the peritoneum was continued up to the origin of the right colic vessel and the right edge of the superior mesenteric vein, when the retroperitoneal portion of the duodenum appeared, injury to which was avoided.

A suitable point in the ileum, preserving the blood supply to the rest, was chosen about 2-4" proximal to the affected segment. An opening was made in the mesentery as near the gut as possible. The vessels were controlled by artery forceps. The mesentery was incised in a wedge shape with its apex at the origin of the right colic artery, securing all the anastomotic vessels between the

right colic and the ileo-colic vessels—the last vessel including the highest affected lymph node in the resection.

Similarly, after the transverse colon had been divided between clamps, an incision was made through the mesentery and extended towards its attachment—the anastomotic branches between the middle colic and the right colic arteries having been secured. The proximal portion of the omentum was separated from the transverse colon.

By this means a complete block removal of the whole related lymphatic area was achieved. This left for anastomosis, two segments of bowel—the ileum and the transverse colon, both invested with a complete serous coat.

A more limited resection consisting of a few inches of the terminal ileum, the caecum and a portion of the ascending colon was carried out, when the caecum alone was affected.

Venous oozing from the retro-peritoneal area was readily controlled by hot moist packs.

The free ends of the bowel were closed by the sewing machine technique—Fig. 14. A side to end or side to side isoperistaltic anastomosis was made. The closed free ends of the bowel were anchored.

Peritonisation of the raw surface was done with meticulous care. The defect in the mesentery was closed by overlapping the lateral and the medial free edges together with a few stitches.

Routine installation of about 6 gms. of sulphanilamide powder in the paracolic gutter proved useful and in some cases intra-peritoneal instillation of penicillin through a catheter, 50,000 units b.d. for a period of 4-7 days, was done as prophylactic against peritonitis.

The patient usually left the theatre in a satisfactory condition. The following regime was instituted for the first 48 hours:

1. Nothing by mouth or rectum.
2. I.V. glucose saline; blood if necessary.
3. Morphia 1/6 grain every 6 hours.
4. Attention to oral hygiene.



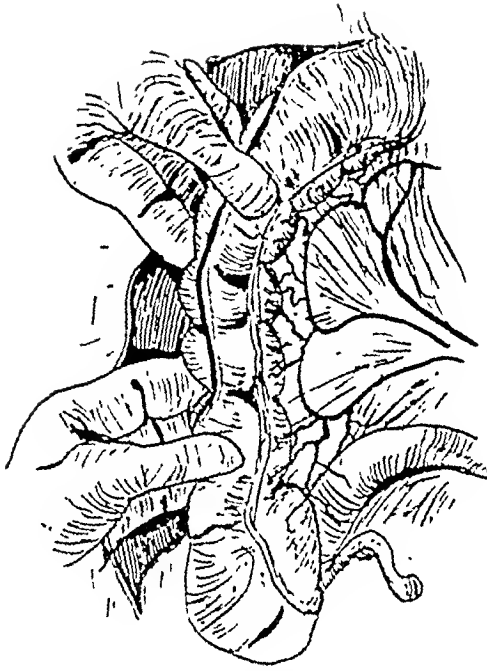


Fig. 10.

The caecum and the ascending colon elevated, after the incision of the peritoneum along its lateral reflection.

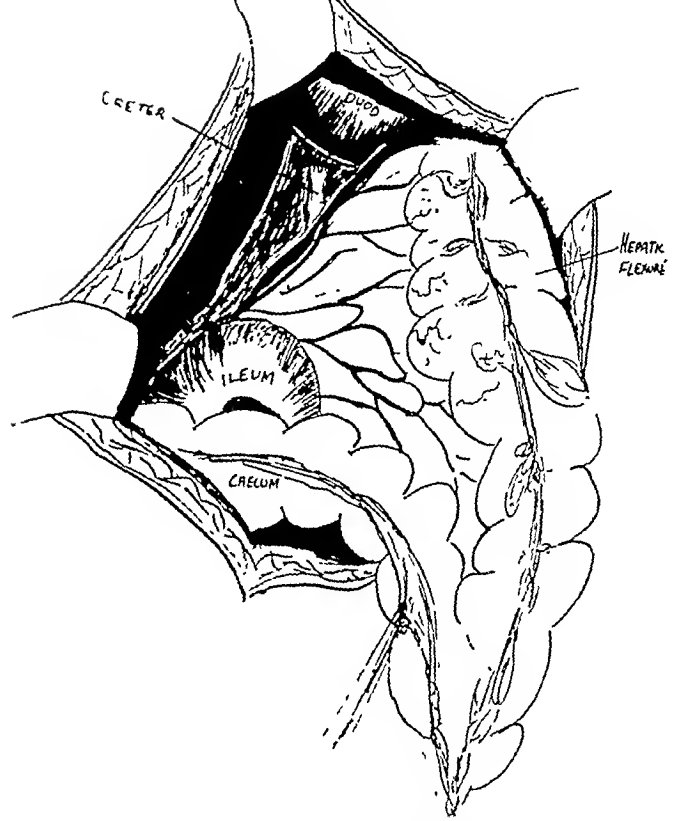


Fig. 11.

Mobilization of the caecum and the ascending colon.

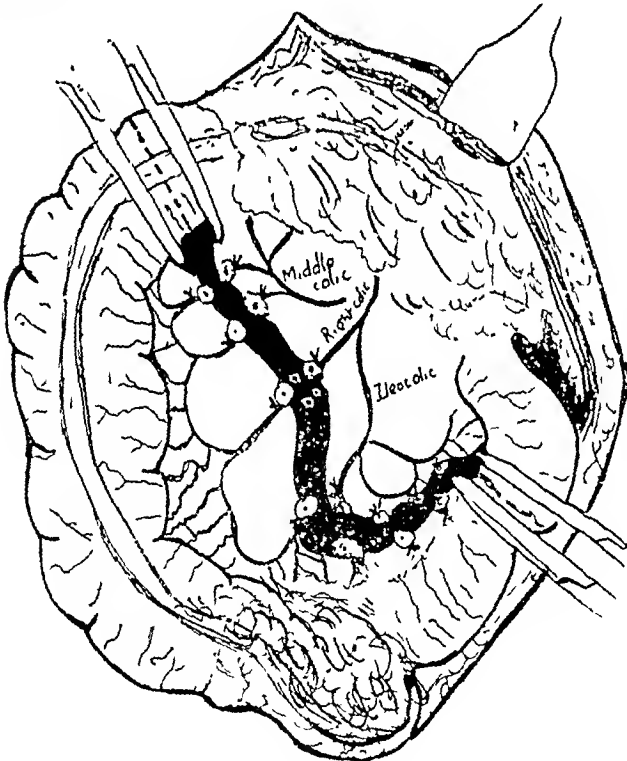


Fig. 12.

Ligation of the vessels at their origin and resection of the mesentery.

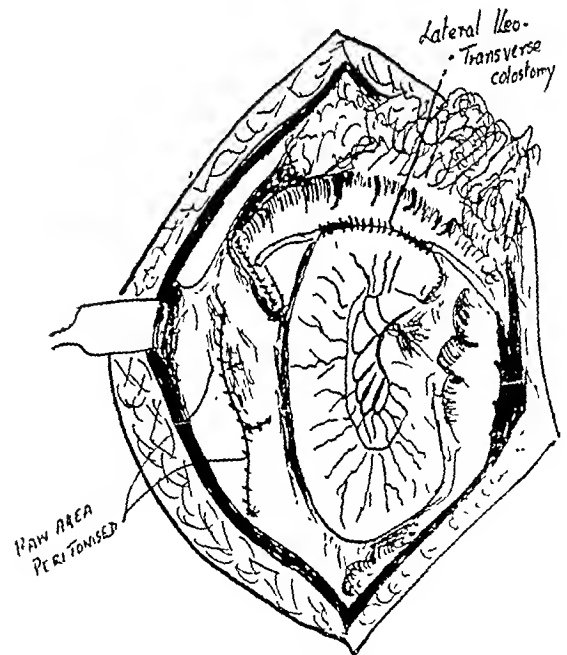
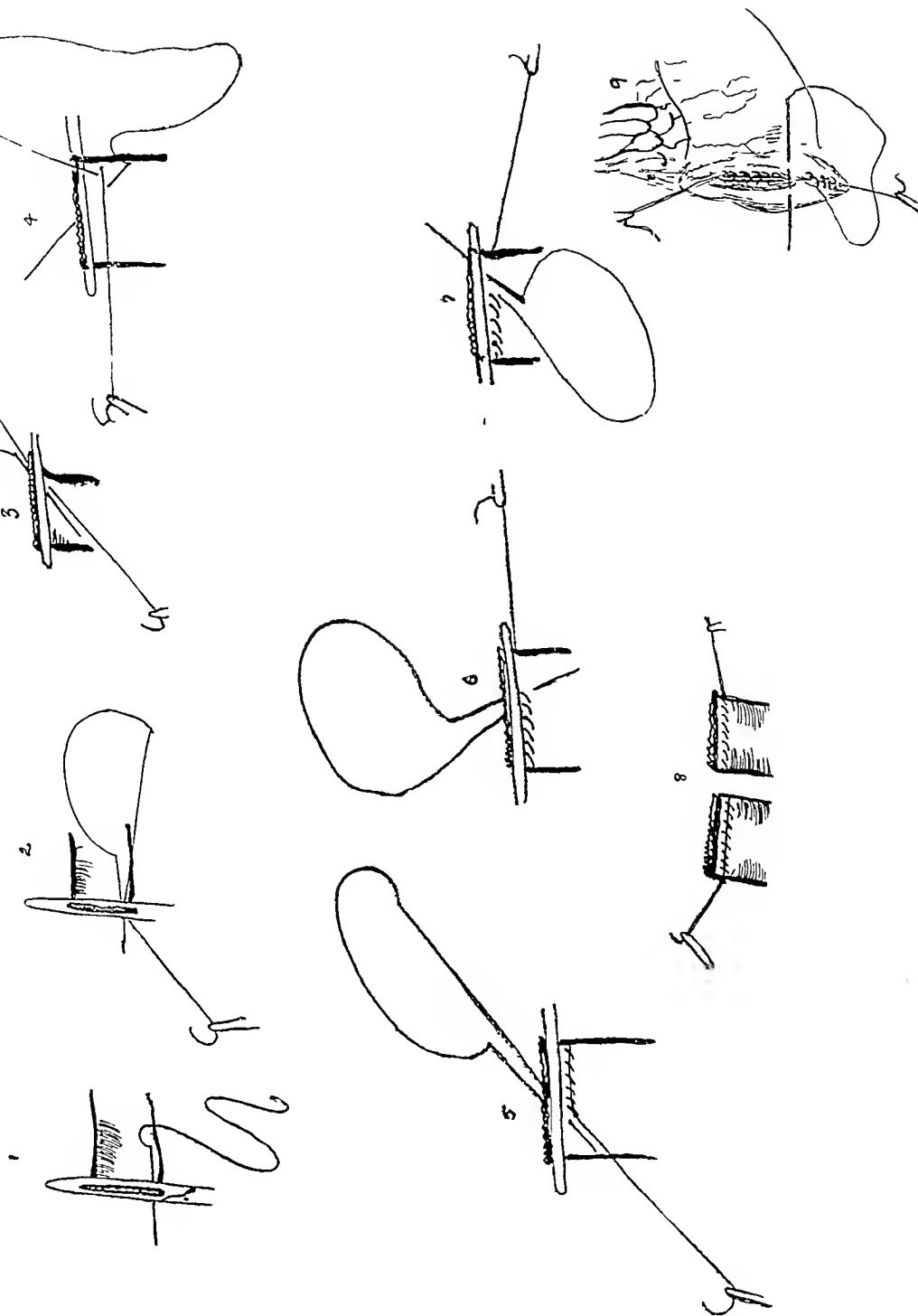


Fig. 13.

Ileo-colic resection—anastomosis completed.

# CLOSURE OF THE DIVIDED END OF BOWEL



Completed by  
two rows of  
sero muscular  
stitches.

Only sips of fluid were given until free passage of flatus. Enemata were avoided during the first week; glycerine enema sufficed when there was an indication.

### Case Reports

**CASE 1.** A girl aged 15 took ill suddenly with pain in the abdomen and vomiting. She had an attack of pain localised to the periumbilical region 6 months ago. There was tenderness and rigidity over the right half of the abdomen. Her temperature was 101.2°. The rising pulse rate and the falling B.P. demanded a laparotomy after the usual pre-operative measures to combat dehydration and shock. A pint of yellowish pus was evacuated. The proximal ileum showed a large tuberculous ulcer which had perforated. The ulcer was closed with omental graft. The patient expired after four hours.

**CASE 2.** A destitute aged 40 was admitted to the hospital with symptoms and signs of acute intestinal obstruction. Repeated enemata ended in failure to relieve the obstruction. A palliative ileostomy was performed under local anaesthesia by the resident surgeon. The patient pulled out the ileostomy tube the next day and this necessitated a laparotomy. The abdomen was opened through a right paramedian incision. The terminal ileum, caecum and the ascending colon were involved in a tuberculous process and the terminal ileum had intussuscepted into the caecum. The patient expired on the table before the resection of the gut could be completed.

**CASE 3.** Miss S., aged 16, complained of attacks of severe abdominal pain with distension, irregular fever and feeling some masses at times in the abdomen. On admission she was running a moderate afternoon temperature. She was pale, emaciated and was toxic. Sausage-shaped masses were palpable in the abdomen and since these masses disappeared and reappeared in the right iliac fossa, the case was investigated for ileo-caecal pathology with subacute obstructive signs. The barium meal evidence was in favour of a lesion in the ileo-caecal region. A diagnosis of ileo-caecal tuberculosis was made. The lung showed no active lesion. She was subjected to an exploratory operation under general anaesthesia. The terminal ileum, caecum and ascending colon showed extensive tuberculous involvement. This portion of the gut was resected and ileo-colostomy was performed. The patient improved remarkably after the resection, and the temperature touched normal the day after the operation; toxæmia disappeared and she gained weight.

**CASE 4.** Miss G., aged 15, was admitted for pain in the abdomen. Her father died of tuberculosis. She was running an evening temperature, had cough and suffered from alternating diarrhoea and constipation. She was anaemic, emaciated and weak. A lump measuring 3" x 1" was felt

in the right iliac fossa and gurgling was elicited during palpation. Radiological examination of the chest revealed an opacity in the right infra-clavicular region. Barium enema showed a filling defect in the caecum. Under general anaesthesia the terminal ileum, caecum and the ascending colon (the seat of tuberculous infection) were resected and continuity established by ileo-transverse colostomy. The clinical condition of the patient improved very much and a skiagram of the chest taken just before discharge showed the disappearance of the opacity in the lung.

**CASE 5.** Mrs. P., aged 23, reported for gaseous dyspepsia and abdominal distension with discomfort since two months. She was weak and complained of loss of appetite and loss of weight. On admission she was anaemic and toxic. A mass was palpable in the region of the umbilicus and visible peristalsis was noticed in that area. X-ray of the chest showed an opacity in the right upper zone and barium enema showed a filling defect in the caecum. The abdomen was opened under general anaesthesia. The peritoneum and the ileo-caecal region were involved in a tuberculous process. A first stage ileo-colostomy was done with a view to resect the involved gut during a second operation. There was no clinical improvement. After 47 days the abdomen was reopened. An extensive resection consisting of the terminal 8' of the ileum, the caecum and the ascending colon was undertaken. The liver had undergone advanced fatty degeneration, almost nutmeg in appearance. In spite of adequate post-operative measures, the patient developed jaundice after a week and she died on the 8th day after the operation.

**CASE 6.** Mrs. P., a small built woman, aged 25, sought admission for attacks of pain in the right iliac fossa of one year's duration. She noticed a mass in that region and this was steadily growing in size. She was suffering from alternating diarrhoea and constipation and was passing blood and mucus in the stools. She had attacks of cough during nights and was running an afternoon temperature. A firm, tender gurgling mass was palpable in the right iliac fossa. Barium enema failed to define the contour of the caecum and there was filling defect in the caecum in the barium meal series. Skiagram of the chest did not reveal any pulmonary pathology. Under general anaesthesia, a right hemicolectomy was done. The microscopic examination revealed a tuberculous and an adenocarcinomatous lesion of the caecum--  
Fig. 9. (to be concluded.)

### ACKNOWLEDGEMENTS

This paper is based on the work undertaken on enterocolic tuberculosis, under the kind auspices of the Indian Research Fund Association. Our thanks are due to the Professor of Pathology, Madras Medical College, for his help and advice. Grateful acknowledgements are due to the Superintendent of the Government General Hospital, Madras, for kind permission to use the clinical material available there.

# CONGENITAL ANOMALIES OF THE BILIARY APPARATUS

by S. C. GUPTA, Calcutta.

An anomalous biliary structure is not an uncommon condition in human beings. Eisendrath stated that abnormality of the bile duct system was found in about 8% of normal necropsies in men. But according to Flint and Brewar abnormal duct and arterial system are more common than what we know to be normal. Flint dissected 200 dead bodies and found normal arrangement in only 69 cases, whereas Brewar met with 3 normal cases in 50 dissections.

Mentzer is of opinion that congenital abnormality of the biliary apparatus in men is but a normal arrangement in some lower animals. A human congenital anomaly in this region is therefore persistence of the lower animal condition.

## Development and Anomalies

The biliary apparatus is developed from the caudal part of the hepatic bud which arises from the foregut and projects into the ventral mesentery. The cranial end of the bud bifurcates and each bifurcation branches into a large number of solid cords of liver cells. Channels appear in them by the fourth week of foetal life and the cells begin to function at the twelfth week. The gall-bladder arises as a diverticulum from the caudal part of the hepatic bud. The variations of the biliary apparatus are many and these have been reported from time to time by anatomists and operating surgeons. To mention a few, the names of Kehr, Eisendrath, Haberland, Boyden, Flint, Mentzer and Paul have been associated with these conditions. Knowledge of these anomalies helps the surgeon to avoid injuries during operations on the gall bladder and biliary passages.

The various congenital anomalies of the biliary apparatus in men reviewed in the light of comparative anatomy and recorded up till now are :

### 1. ANOMALIES OF THE HEPATIC DUCT SYSTEM.

(i) *Variations in number.*—Complete absence of the hepatic duct on one or

both sides is an uncommon finding though cases have been reported by Hill, Witzel and Simpson, the more common anomaly being multiple hepatic ducts. Descamps found multiple hepatic ducts in 12% and Flint in 15% of cases. The accessory hepatic ducts terminate in the gall bladder, cystic duct, main hepatic duct, common duct or any part of the gastrointestinal tract from the stomach to the upper jejunum. It appears that the termination of the duct in the stomach or small intestine is dependent upon the nature of the food on which the animal lives. In carnivorous animals the opening is in the stomach or near about, whereas in herbivorous animals the opening is in the distal duodenum or upper small intestine.

(ii) *Variation in shape.*—A hepatic duct may be dilated to form a cyst. The presence of such an anomaly has been reported by Eisendrath, Flint and Brewar. The cyst drains into the gall-bladder, cystic duct or common bile duct. This anomaly is found normally in many fishes, birds, reptiles and mammals.

### 2. ANOMALIES OF THE GALL-BLADDER

(i) *Variations in number.*—The gall-bladder may be congenitally absent or it is present in early foetal life to disappear at a late stage. The gall-bladder does not develop in some fishes, birds and mammals, e.g., giraffe. Complete absence has also been reported in man, but this is a very rare condition. Accessory gall-bladder, i.e., more than one gall-bladder but with one duct, diverticulum of the gall-bladder and double gall-bladder, i.e., two separate gall-bladders with separate ducts, are reported in human beings but they are normal findings in animals like cod-fish and cat.

(ii) *Variations in position.*—The gall-bladder may be completely buried in the liver substance or may have a mesentery. In python and some fishes the gall-bladder is situated some distance away from the liver, being suspended by a mesentery. Sometimes

the gall-bladder is situated to the left of the ligamentum teres. In animals belonging to Phalangista and Marsupial groups gall-bladder on the left side of the ligamentum teres is a common finding. It is attached to the ligamentum teres in Myrmecophaga. A case has been reported by Wischnewsky where the gall-bladder was situated partly on the right and partly on the left of the ligament as a vesicle.

### 3. ANOMALIES OF THE CYSTIC DUCT

(i) *Variation in number.*—The cystic duct may be completely absent and the gall-bladder opens directly into the common hepatic duct or it may be so short that the gall-bladder is almost directly attached to the common hepatic duct. This condition is normally present in monkeys. The cystic duct may be multiple and such cases have been reported by Kehr, Dressman, and Haberland. Multiplicity of the cystic duct has been found in lower animals as well.

(ii) *Variation in terminations.*—The cystic duct joins the left or right hepatic duct, common duct near the ampulla or in the pyloric part of the stomach or duodenum directly. Numerous instances of variations of termination of the cystic duct have been noted by Kehr, Flint and others in human beings and the same have been found similarly in some fishes, reptiles and some herbivorous animals.

### 4. ANOMALIES OF THE COMMON DUCT

Complete congenital atresia of the common duct has been reported by Mohr. In many animals hepatic ducts and cystic duct drain separately into the intestine and there is no mixing of the gall-bladder and hepatic secretions. Multiple common ducts have been reported by Kehr and Curvoizer. The common duct has been reported to terminate in the stomach in man, which is a special feature of common duct termination in some fishes.

Congenital cystic dilatation of the common duct is a recognised abnormality which in the majority of the cases recorded involved the supra-duodenal part of the duct. The condition is most probably a congenital anomaly arising from inequality in the rate of epithe-

lial proliferation during the stage of occlusion of the primitive choledochus. The cyst varies considerably in size, the largest one recorded contained a pint of bile.

### Case Report

I am presenting a case of anomalous biliary apparatus, which I met with in a female patient, aged 35 years, in the course of an operation of cholecystectomy on 19-4-'48:—

Abdomen having been opened by Kocher's incision, the gall-bladder was found to be concealed from view by old adhesions with colon and omentum. These were separated to expose the viscus, which was enlarged, thick-walled and pinkish white in colour. It was so to say packed with calculi. The neck (Hartman's pouch) was bulbous, and contained a stone. The bulbous neck was so situated, that the identification of the arrangement of the duct systems in the junction region was difficult. This was therefore opened by incision along its axis and the calculus inside extracted. The procedure, however, did not improve matters. Further investigation into the cul-de-sac showed that thin clear bile was pouring into the saccular neck through an opening on the hepatic side, which on careful examination was found to be the opening of the common hepatic duct, with a thin vertical partition in its middle, representing the right and the left hepatic ducts. Another opening was found at the duodenal side of the pouch which proved to be the commencement of the common bile duct from the gall-bladder (Fig. 1). It was then realised that one

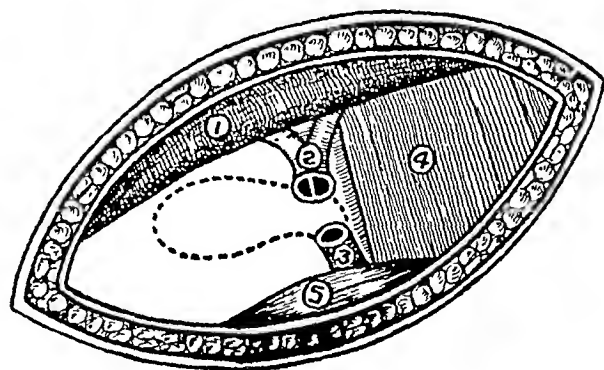


Fig. 1.

1. LIVER.
2. COMMON HEPATIC DUCT. (BI-CHANNELLED)  
OPENING INTO THE DOTTED LINE.
3. DUCT FROM THE GALL-BLADDER TAKING  
THE PLACE OF COMMON BILE DUCT.
4. LESSER OMENTUM.
5. DUODENUM.

was dealing with a very unusual anomaly of the gall-bladder and the duct system. The condition met with, being as stated above, there was no other alternative but to remove the gall-bladder by cutting across the common hepatic and common bile ducts as close to the organ as possible and anastomose them. This having been done an end-to-end anastomosis of the duct was performed in a similar way as arterial anastomosis (Fig. II).

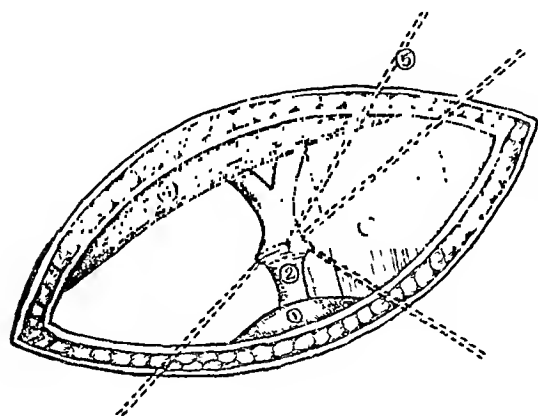


Fig. 2.

1. DUODENUM.
2. CYSTIC DUCT & COMMON HEPATIC DUCT SUTURED.
3. LESSER OMENTUM.
4. LIVER.
5. STAY-SUTURE.

Fortunately the anastomosis could be performed without much tension. A tape like piece of the omentum was cut out and wrapped round this anastomosis for additional protection. No. 12 size soft catheter was fixed to the site of anastomosis and a cigarette drain was placed in the space of Morrison, and the abdomen was closed in layers. The removed gall-bladder (Fig. III) measured 5½" x 2½". It was considerably thickened. It had a dumb bell shaped appearance due to very prominent and saccular dilatation of the neck of the organ. There were multiple faceted calculi in the body and a round one in the Hartman's pouch. There were openings of two ducts in it. One towards the liver divided by a septum, the opening of the bichannelled hepatic duct. The other towards the duodenum was that of the common bile duct from the gall-bladder.

The post-operative period had nothing particular to mention. There was a fair amount of bile leakage. But this stopped on 9-5-48 (20th day after the operation). The patient was discharged cured on 18-5-48. She is keeping good health and reported last on 16-6-49.

## Remarks

From a review of the literature at my disposal, I have neither been able to meet with a case record of a similar nature, nor to find mention of similar anomaly amongst any animal. Rolleston and McNee in their book "Diseases of the Liver Gall-Bladder and Bile Duct" made reference of a case reported by Cruicknell in the Transactions of

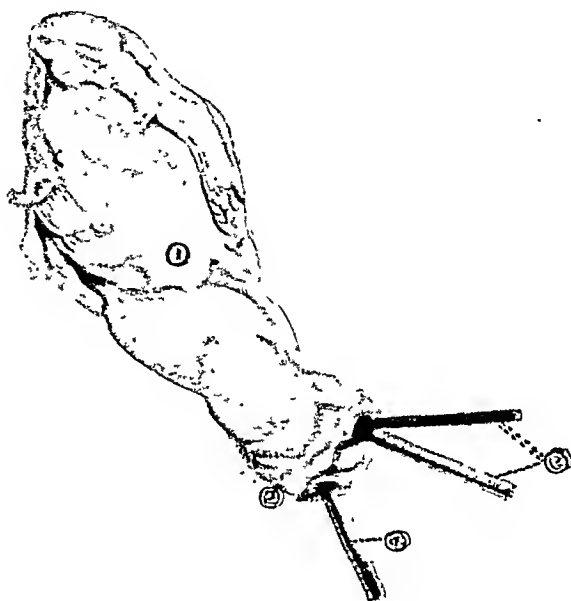


Fig. 3.

1. SHOWS THE REMOVED GALL-BLADDER WITH COMMON HEPATIC DUCT TERMINATING IN IT AND THE DUCT OF THE GALL-BLADDER REPLACING THE COMMON BILE DUCT.
2. HARTMANN'S POUCH.
3. TWO STICKS IN THE BI-CHANNELLED COMMON HEPATIC DUCT OPENING IN THE GALL-BLADDER.
4. STICK IN THE DUCT COMING OUT OF THE GALL-BLADDER AND TAKING THE PLACE OF THE COMMON BILE DUCT.

the Pathological Society, London, 1871, in which the common hepatic duct opened in and the common bile duct originated from the gall-bladder. The authors suggested that the case was probably one of the absence of the gall-bladder with compensatory dilata-

tion and pouching of the upper end of the common duct. I could not secure the original case report, so I am not in a position to discuss it. But the suggestion put forward by Rolleston and McNee does not appeal to me. In case of congenital absence of the gall-bladder, common hepatic duct opens directly in the intestines and no differentiation can be made between the common hepatic and the common bile ducts. Compensatory pouching and dilatation should be the result of an obstruction below it. No mention has been made of such a cause being present in Crucknell's case nor of the existence of any pathological condition in the gall-bladder. It would not also be right to consider the case as a choledochus cyst, as in all reported cases of choledochus cysts the gall-bladder existed as a separate organ.

In the case presented by me, the arrangements of the ducts were somewhat similar to the case mentioned above but there were very many differences that would justify considering it as a rare and peculiar congenital anomaly, a reference of the like of which has not been available to me. The gall-bladder was a fully developed organ with obvious pathological changes and contained a large number of stones.

Besides being an uncommon and interesting congenital abnormality, the clinical importance of the case lies in the fact that non-appreciation of its existence of such a condition may lead to serious operative risks if unrecognised.

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# EMBRYOMA OF KIDNEY (WILM'S TUMOUR)

by L. R. PATHAK, *Ludhiana.*

Curiously enough within one and a half years, I came across two cases of embryoma of the kidney, a tumour which is supposed to be quite rare. I am also utilising this opportunity to review the literature on the subject.

The true nature of this tumour was not discovered for a long time hence its numerous names which are Renal Adenosarcoma, Nephroblastoma, Teratoma, Teratoid Tumour, Mixed Tumour, Carcinoma Sarcomatodes, Sarco-carcinoma, Sarcoma of infancy, Rhabdomyosarcoma, Adenomyosarcoma and Dysembryoma etc. It is of greatest frequency in first three years of life and is rare after the age of ten years. According to Burgess (1) it occurs once in 25,000 hospital admissions. Eserksy, Saffer, Panoff and Jacobi (6) have reported three more cases to the previously 54 reported cases of Wilm's tumour occurring in adults. It is almost equally distributed in both the sexes. It is usually unilateral and there is no predilection for either the right or the left kidney. But it may be bilateral, specially in children.

## MACROSCOPIC APPEARANCE

The tumour varies greatly in size being sometimes quite small, but more frequently reaching extraordinary dimensions and in one case weighed 31 pounds. It may start in the cortex of the kidney either at upper or lower pole. It may be smooth and rounded or lobulated and notched and usually of pale grey or bluish white in colour. It is soft or firm and the cut surface is solid, uniform and opaque. The blood supply is comparatively poor with thin-walled vessels and hence the tumour undergoes various degenerations in the later stages like the mucoid degeneration, zones of softening, haemorrhages, necrosis and formation of cystlike cavities.

The tumour invades the renal tissue and destroys it so that only a trace of normal parenchyma usually remains in the later stages. The renal pelvis is compressed and obliterated, but its cavity is not actually invaded and therefore pain, and haematuria are wanting. Ultimately the tumour stretches the renal capsule to the breaking point and dis-

seminates rapidly in the retroperitoneal tissues and in the peritoneum, omentum, liver, spleen, intestines and the opposite kidney. Latham (12) has quoted a case in which the tumour projected into and obliterated completely the renal pelvis and had so infiltrated the hilum structures as to obstruct the lumen of not only the renal vein but the renal artery as well. Thus through the blood stream it may metastasise to the lungs and other organs.

## MICROSCOPIC APPEARANCE

The structure varies greatly but it usually consists of masses of round, oval or spindle-shaped cells lying in a scanty matrix as in an ordinary sarcoma. Here and there are usually scattered some tubules lined by cubical or columnar epithelium and having more or less definite lumen. Imperfectly formed glomeruli may also be present. Muscle fibres both plain and striated, fat cells, cartilage and even bone may be present. According to Ogilvie (16) occasionally typical squamous "cell nests" may be found and thus the picture is that of embryonal tissue differentiating into mesodermal and ectodermal elements. In brief it has the characters of a combined sarcoma and carcinoma.

## THEORIES OF ORIGIN

The kidney is an epithelial organ, but it arises from mesoderm. If the sections of a developing kidney are examined the tubules are seen to develop from undifferentiated cellular connective tissue. This is just the appearance found in Wilm's tumour, and hence the tumour may be regarded as a continuation of an early stage of development. The formation of muscles, cartilage, bone and etc., may be regarded as perversion of mesodermal growth. According to Wilm (22) the tumour is derived from displaced portions of a myotome (primitive body segment) which normally gives rise to a whole excretory apparatus and which later become included in the developing kidney. Moore (15) thinks that Wilm's tumour is probably derived from some primitive mesenchymal, multipotent kidney cells which become isolated and imprisoned in part of the



developed organ and later in response to some unknown stimulus begin to grow and give rise to all the various tissues which may occur in the neo-plasm. He quotes a case in which the tumour was definitely known to have been present for sixteen years and trauma sustained two years before onset of symptoms was the stimulus which stirred these cells into activity.

Dean and Pack (3) give an excellent review of various theories. They conclude that (i) the tumour originates at different developmental periods of embryo as there are large number of tissues represented. (ii) The renal blastoma of nephrotome is a predominating contributory structure and a tumour analage which establishes itself at this stage will elaborate tissues easily recognised as renal in origin like primitive renal tubules and even *glomeruli*. (iii) In a tumour analage which separates earlier, before the urogenital ridge has formed the nephrotome, there is a large number of possibilities for elaborating multiple tumour cells which may account for the presence of muscle fibres both smooth and striated, occasional fat and cartilage cells, the sarcomatous and tubular elements, all derived from primitive germinal tissues.

#### CLINICAL FEATURES

In the early stage the clinical features may be notoriously and characteristically absent. According to Latham (12) the general well being of the patient is usually very slightly or not at all affected. The child may be fussy, fretful, pale and off its feeding for several days (thought to be due to teething, etc.) periodically feverish and the urine may be occasionally "sort of rusty". The first thing to be usually noted is an extremely rapid growing mass in the kidney region. The mass is usually firm, smooth non-fluctuating and freely movable. Sometimes it may be lobulated and notched. According to Fusaro (7) the enlargement is the first symptom in about 85% of cases in children whereas in adults the enlargement is the first symptom in only 23% of cases. Pain is very rare in children, is present only in 7% to 8% of cases while in adults it is often the first symptom. Pain when found is usually present in the back and loins. Hae-

maturia, casts and albumin in the urine are usually the last findings if they occur at all. In the majority of cases repeated urine examinations are negative till the end. In adults, however, urinary findings are common.

It is not until the end of the illness that there is rapid loss of weight and malaise and red cells and haemoglobin rapidly go down and cachexia ensues. Walker (21) states that increasing abdominal distension with ascitis may appear. At this stage digestive disturbances set in varying from nausea to severe vomiting. There is usually severe constipation but it is not uncommon to find diarrhoea with foul greenish stools.

The duration is only a matter of months, death resulting from general dissemination or from exhaustion or may follow the detachment of an embolus which may block the pulmonary vessels. Tanner (20) reports a case in which death occurred because of a spontaneous rupture while the child was asleep, as a result of very rapid growth and haemorrhage into its substance.

#### DIAGNOSIS

These tumours are not diagnosed any earlier or more frequently to-day than they were 50 years back. The clinical history and examination, specially the bimanual examination (one hand in the costovertebral angle and the other on the front of the abdomen) lead to their recognition. There are no early symptoms. The so called diagnostic triad of haematuria, pain and abdominal mass is of no value in children as the only feature in them may be the rapidly growing mass.

Plain X-ray of abdomen usually reveals a more or less dense shadow in the affected flank with concomitant medial displacement of the intestinal gas shadows. Pyelograms may not only be helpful in diagnosis, in evaluating the kidney function and displaying the outline of the kidney but also in guiding the surgeon in his approach to the technical problems of its radical excision.

Subcutaneous or intravenous injection of "diodrast" is quite simple and in many instances satisfactory results are obtained. If results are not successful and if it is con-

sidered that pyelograms are necessary for the diagnosis, the retrograde method is used.

The so-called characteristic pyelographic changes seen in a Wilm's tumour are:—

- (1) Distortion of the renal pelvis and calices.
- (2) Displacement of renal pelvis upwards, downwards and lateral wards depending on the position of the tumour within the kidney.
- (3) Failure of visualization of the kidney pelvis.

However, it should be remembered that these described changes are not absolutely diagnostic, but merely suggestive of a Wilm's tumour. When no contrast medium can be seen in the pelvis or calices on the affected side, the diagnostician must think of hydronephrosis as well as neoplasm.

Deming (5) advocates repeated roentgenographic examinations to facilitate the diagnosis in questionable cases. He also emphasises the difficulty of surgical extirpation of a fixed kidney with tumour and suggests that the mobility of the organ can be determined at the time of pyelography.

Ladd (10) states that although it has been the practice to obtain an intravenous or retrograde pyelogram in all cases where the diagnosis is in doubt, there are certain valid objections to make the latter a routine practice as it means a delay before nephrectomy as cystoscopic examination in the age group in which the tumour occurs requires a general anaesthesia. A distorted pelvis may be present in other conditions and absolutely normal appearing pyelograms may exist in the presence of a very large embryoma.

Aspiration biopsy is now discarded because of the risk of setting malignant cells free into the peritoneal cavity. Marked response to radiation may be of diagnostic value.

Considering all the above, diagnosis is still impossible many times and exploratory laprotomy may be resorted to which should not be delayed in these cases.

#### PROGNOSIS

Loughnane (13) reports 35 cases from various London Hospitals. Recurrence took

place in over 80%; in 70% within one year after nephrectomy. Out of his 13 personal selective nephrectomies, there was one death from operation only and late results were: results unknown 3 cases, survived 3 years or more 4, alive and healthy 1½ years after operation 2; died from intercurrent of phthisis within 3 months 1; died of recurrence within 6 months 2.

Robin (19) reports 4 cases, one of which was well and without recurrence 22 months after operation.

Gage and Adams (8) report 3 cases, two of which died within 9 months, one case was alive and free of metastasis five months after operation.

Mixter (14) thinks that the outlook for patients who have survived a two-year period without recurrence is better than in other types of malignancy as recurrence and death so rapidly follow in the vast majority of renal neoplasms of childhood. In his series of 14 cases, the immediate operative mortality was 35%; and out of 9 survivals all showed rapid recurrence and death except one who was alive and well 3½ years following nephrectomy.

Campbell (2) reported a case of 13 months who was given pre-and-post-operative irradiation and showed no evidence of metastasis 15 months after operation.

Ladd (10) reports a series of 45 cases out of which 31 died. Of these 31, all but one had a recurrence and died within one year of operation. Of the 14 patients who are still living, 11 may be classified as possible cures, the length of time since nephrectomy varying from 1½ years to 19½ years.

Kerr (9) reports 14 cases in children, two are still alive and without evidence of disease 59 and 52 months after admission; one had previously shown pulmonary metastasis. They were administered a full course of irradiation followed by operation.

According to Esersky and others (6) the prognosis is more unfavourable in adults than the known poor prognosis in children.

#### TREATMENT

Treatment is greatly variant as the structure of the tumour differs in different cases

depending upon the developmental period of the embryo when the tumour took origin. It is also influenced by the rate of growth and response to various types of treatment. The duration of the disease and the general condition of the patient and the rapidly with which the metastasis has been seen to occur in the patient are other deciding factors.

Ladd (10) states that "surgical excision is the only hope" and should be carried out without any delay and without pre-operative irradiation.

The question of operability must necessarily be decided after consideration of various factors like the size of the tumour, the presence of metastasis, general condition of the patient and the experience of the surgeon. Pre-operative treatment consists in physiologically preparing the patient by means of parenteral glucose saline, plasma and blood transfusion. The transperitoneal approach is better than the anterior extra-peritoneal or the postero-lumbar approach as the latter does not give adequate room for removal of even a moderately large tumour. A large paramedian incision is employed. After opening the peritoneum the colon is reflected towards the opposite side, sufficiently to expose the renal pedicle and the ureter. Care must be taken to avoid displaced structures like inferior vena cava. The renal vessels and ureter are first ligatured and cut, before any attempt is made to mobilise the kidney, so that dissemination of tumour cells may not take place. The whole mass is then removed care being taken not to tear the capsule. The peri-renal fat particularly along the renal pedicle is also removed as the lymphatic extension is most likely to take place here. After all bleeding points have been controlled the posterior abdominal wall is re-peritonised and the anterior abdominal wall is closed in layers without drainage. Post-operative treatment consists in parenteral glucose saline, plasma and sometimes blood transfusion and morphia.

Post-operative irradiation was formerly employed only in those patients in whom regional metastasis were grossly evident at the time of operation or if microscopic examination of the regional lymph glands showed metastatic involvement. However now the

policy of giving all the patients post-operative irradiation has been adopted as it is now felt that all the patients should have the benefit of possible life-saving post-operative irradiation.

Ladd & White (11) in reviewing 60 cases stress immediate surgery as soon as the diagnosis is made. They advise immediate surgery because during the time that is required for pre-operative irradiation and the waiting period for surgery the chance of metastasis by way of blood vessels is very good. They are also of the opinion that pre-operative radiation for shrinkage of the tumour may force malignant cells into the blood circulation. Of the sixty cases so managed fourteen were probably cured and in four the operation was too recent to reach any conclusion.

Randal (18) states that the late arrival of these cases to the consultant surgeon owing to lunacy of the symptoms renders the operative removal both hazardous and at times impossible. Pre-operative irradiation not only decreases the operative hazard by reducing the size of the tumour but also minimising the additional danger of manipulative and traumatic spread of malignant cells. He also considers it important to include the chest and abdomen in the pre-operative irradiation in order to attempt to create an infertile field for metastatic transplants that may be dislodged by the handling of the tumour at the time of operation. The choice of time for operation, after completion of thorough irradiation appears to be between the 4th and the 6th week.

Priestley & Broders (17) state that "in the study of tumours removed at operation which were subjected to pre-operative irradiation one may find an island of glandular or sarcomatous-appearing cells growing luxuriantly in the midst of necrotic debris the result of irradiation on surrounding cellular structures." They conclude therefore that the pre-operative irradiation followed in 3-6 weeks by nephrectomy with extensive post-operative irradiation is the treatment of choice.

Dean (4) employed irradiation alone in 20 cases in the past 15 years and reports that 5 of the patients are living without any evidence of metastasis, five or more years after

treatment. In spite of this high percentage of cures, he does not recommend this procedure because even in most radio-sensitive cases it probably required many months to devitalize the tumour completely and during this time metastasis can take place. He reserves exclusive irradiation for those cases that are not fit for surgery and in whom metastatic lesions are already present.

According to Thomson Walker (21) embryoma is specially sensitive to radium because of its vascular and undifferentiated character. Radiation causes vascular thrombosis and subsequently local necrosis.

Burgess (1) remarks that certain operators have reduced the mortality of 98% during the period from 1914-1923 to 40% from 1932 to 1941 by removing the tumour as soon as the diagnosis has been made clinically without pre-operative X-ray therapy. He states that irradiation has never destroyed a metastatic lesion.

The various methods of treatment may be summarised as (1) Surgery alone (2) Surgery with pre-operative radiation. (3) Surgery with post-operative radiation. (4) Surgery with pre-and post-operative radiation. (5) Radium therapy alone. The result of various methods of treatment are as a whole poor regardless of the method of treatment adopted.

## Case Reports

### CASE NO. 1.

P. K. Sikh female child, 5 years of age was admitted to Arya Medical School Hospital on January 3, 1948 for a mass in the abdomen of five months' duration. The mass when noticed by her mother five months back was the size of an apple and situated in the upper left quadrant of the abdomen. The mass gradually increased in size and became slightly painful. The patient could not stand erect or walk properly. She was slightly constipated. Her development was more or less normal. Various medicines had been tried to cure the mass with no effect. She occasionally had attacks of malaria. There was nothing relevant in the family history.

The physical examination revealed a fairly nourished and slightly anaemic child with slightly unsteady gait. The pulse rate was 85, temperature 98.3°F. and respiration 25 per minute. The examination of the heart and lungs did not show any abnormality. There was no enlargement of lymph glands.

The abdomen was full and markedly distended. The skin was very much stretched out and showed dilated veins. The abdominal wall was rigid and slightly tender specially on the left side. The left abdomen and flank seemed to bulge and had a solid feel. The underlying mass seemed to extend beyond the umbilicus to the right side and downward towards the pelvis. Bimanual examination revealed that the mass was solid, globular, smooth and movable. It was of the size of a volley ball. It did not move with respiration. The spleen was enlarged to two fingers below the costal margin but was distinct from the mass. The percussion over the mass gave a dull note. The right kidney and liver were not palpable. There was no shifting dullness.

Urinalysis showed the urine to be pale yellow, clear, acidic in reaction, specific gravity 1013, albumin in traces, red cells 2-3 per field and pus cells 4-5 per field.

On January 5th, blood showed red cells, 4,000,000 c.mm. haemoglobin 65% white cells 16,000 c.mm. neutrophils 65% lymphocytes 31%, monocytes 3% eosinophils 1%; bleeding time was 3 minutes and coagulation time 3½ minutes.

On January 6th. plain skiagram of the abdomen showed left dome of diaphragm raised and a large opaque shadow in the upper left quadrant of abdomen.

On January 8th an excretory pyelography showed no clear appearance. Right kidney pelvis was slightly outlined, but the left pelvis was not at all visualised; the appearance suggested a tumour of the left kidney.

On January 10th, the patient was operated upon under ethyl chloride and ether anaesthesia. Blood for transfusion could not be arranged. A left paramedian incision extending from costal margin to the pelvis was made. On opening the peritoneum many loops of distended coils of small intestine protruded. The small intestine was walled off and the peritoneum along the left gutter lateral to the descending colon was incised so that whole of the descending colon along with splenic flexure, transverse colon and sigmoid could be retracted towards the right. This exposed the mass almost in its entirety. It was found to arise from the upper part of the left kidney, and was occupying the whole of the perirenal region extending upwards towards the spleen, downward towards the pelvic brim and displacing the descending and transverse colon towards the right. The kidney pedicle was separated, calmps applied and cut. The ureter was traced downwards so far as possible and cut between the ligatures. The tumour was easily dissected out from the parietes. The bleeding was controlled. The other kidney was normal. The posterior peritoneum lateral to the descending colon was sutured and the anterior abdominal wall was closed in layers. No drainage was provided.

The tumour was pyriform shaped, with greatest diameter in the, upper part, of about 7 in-



Fig. 1.

The Wilm's Tumour removed from case no. 1, showing that it has replaced almost the whole of the kidney except the lower pole.



Fig. 2.

Longitudinal section through the tumour from case no. 1, showing a homogenous smooth surface with some softening at places.

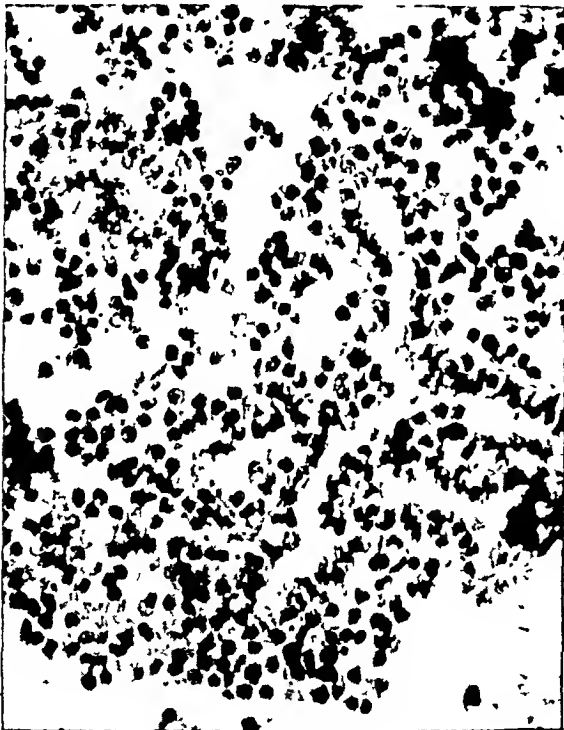


Fig. 3.

Photomicrograph of the Wilm's tumour showing round and oval cells with densely stained nuclei. The matrix is very delicate and scanty. Tubular formation with cubical cells lining the lumen is seen at two places.



Fig. 4.

Case no. 1, twelve days after the operation.

ches, smooth but nodular, firm and solid, pale blue in colour. Its weight was 1,375 grammes. The capsule was intact all over. It was arising from the upper pole as seen in Figs. 1 and 2. The cut surface showed a homogenous smooth surface with some softening at places.

Microscopic examination showed cells of various shapes i.e. round, oval and cubical with densely stained nuclei arranged in alveoli and at places there was formation of tubules with definite lumen and lined by cubical cells. The stroma was poorly stained and scanty. (Fig. 3) Pathologic diagnosis—Wilm's tumour.

After operation the patient was in severe shock with pulse very weak and fast. She was given continuous intravenous glucose saline. She made an uneventful recovery and gradually improved in health as seen in Fig 4. She was discharged on 22nd January, 1948 and referred for deep X-ray therapy.

On June 5th, 1948 the patient reported for examination. She had gained in weight and was free from metastases. She was asked to report every six months.

On August 10th, 1949, she had further improved in health and was free from metastases.



Fig. 5.

Case no. 2,, on admission.

#### CASE NO. 2.

N. S., a Sikh male child, 3 years of age was admitted to Arya Medical School Hospital on May 27, 1949, with the complaint of a rapidly growing mass in the abdomen. Three months prior to admission, he started passing blood-stained urine which lasted for a few days. A month later his mother noticed a mass in the right abdomen which gradually increased. A general practitioner put a needle into the mass a few days back and a little bloody fluid was aspirated (this should not have been done because of the danger of spread of the tumour cells to the peritoneum). Occasionally the child had attacks of fever. He had been fussy, irritable and not progressing well. His stools were more or less normal. His delivery was normal. The family history revealed nothing of a contributory nature.

Physical examination revealed a weak and anaemic child having slight respiratory distress. The pulse rate was 95, respiration 30 and temperature 98.2°F. Examination of the chest did not show any abnormality with the exception of a systolic haemic murmur in the mitral, aortic and pulmonary areas. There was no lymph gland involvement. There was slight dehydration.

The abdomen was markedly distended specially on the right side as seen in Fig. 5. The skin was tense and showed a few dilated veins in the right upper quadrant. A mass about the size of a toy football could be readily outlined occupying the right hypochondrium and the right lumbar regions and extending into the epigastric, umbilical and right iliac regions. There was slight tenderness and rigidity over the mass. Bimanual examination revealed that the mass extended to the right flank and back and was movable but did not move with respiration. It was firm, solid, globular and irregular. The mass was distinct from the liver. Percussion note over the mass was flat. No free fluid was detected in the abdomen. The left kidney was not palpable. The spleen was not palpable. Rectal examination did not reveal anything.

Urinalysis showed the urine to be straw-coloured, clear, acidic in reaction, specific gravity 1020 with albumin in traces, puscells 8 to 10 per field, red blood cells 3 to 4 per field and B. coli +.

On June 1st, the blood count showed red cells 3,900,000 haemaglobin 60%, white cells 20,000 c.mm. neutrophils 68%, lymphocytes 30%, monocytes 1%, eosinophils 1%. Bleeding time was 3½ minutes and coagulation time 4 minutes.

On June 2nd, an X-ray of abdomen revealed a large opaque shadow in the right upper quadrant displacing the colon gas shadow to the left.

On June 3rd, an intravenous pyelogram showed the opaque solution in the left renal pelvis but none in the right. Diagnosis of neoplasm of right kidney, probably Wilm's tumour was made.



Fig. 6.

Wilms' Tumour removed from case no. 2. Extensive softening of the tumour is seen.

On June 4th after cutting down on the ankle vein for phlebotomy in order to administer blood transfusion continuously during the operation, the patient was anaesthetised with ethyl chloride and ether. Nephrectomy was performed by the transperitoneal route as in Case No. 1. The child withstood the operation very well.

The mass was about 6" in diameter more or less globular with irregular surface. The consistency was firm and solid, colour was pale grey. Its weight was 430 grms. The capsule was broken in the upper part. The tumour was arising from the upper pole as seen in Fig. 6. The cut surface of the tumour showed degeneration specially in the upper part with areas of softening and haemorrhage.

Microscopic examination of the tumour showed oval, cubical and spindle shaped cells arranged in a sarcomatous fashion, separated by delicate poorly staining matrix. Here and there were scattered some tubules lined by cubical cells, and some imperfectly formed glomeruli. Pathologic diagnosis—Embryoma of kidney.

After operation the child was given blood and glucose saline. He made an uneventful recovery. The child progressed very well and gained in



Fig. 7.

Case No. 2. 13 days after operation.

weight also (Fig. 7). He was discharged on June 17 and was referred for deep X-ray therapy.

On August 10, 1949, the patient reported for follow-up. His abdomen showed metastases. On enquiry it was found that the parents had disregarded all advice about post-operative irradiation. The urgency of the matter was re-explained to them. The child has now been given a course of deep X-ray therapy.

Further progress of the cases will be reviewed later.

### Summary

1. Embryoma of the kidney is common in the first 10 years of life and commonest in the first three years.
2. They are definitely embryonal in origin.
3. The growth of the tumour is very rapid. In both the cases reported the tumour reached enormous size within 3-5 months.

4. The kidney could easily be identified in all the cases. It does not take part in the growth. Development of the tumour is independent of the kidney.
5. The chances of metastasis are more if capsule of the tumour is ruptured as in case No. 2. and less if it is intact as in case No. 1, who is still without secondaries, 1½ years after operation.
6. The patients usually reach the surgeon late as accompanying symptoms are mild and few, and are delayed.
7. Various methods of treatment are discussed. The most favoured method is immediate operation with post-operative irradiation.
8. The prognosis is even more unfavourable in adults than the known poor prognosis in children.
9. If the patient remains free from metastases for two years after operation, chances are that he would remain free of them for the rest of his life.
10. Two case reports are presented.

I must thank Dr. P. N. Bawa and Dr. Vaux, the Pathologists, for the keen interest they took, and Drs. M. M. Jalota, P. N. Sami and M. G. Abbot for their valuable help. I am also highly indebted to Dr. V. R. Khanolkar of the Tata Memorial Hospital, Bombay, for the photomicrograph.

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# TRANSPLANTATION OF URETERS INTO THE COLON

By K. N. RAO, Bellary.

The primary purpose of this article is to trace the development of the technique of the operation and to draw the attention of the surgeons, urologists and gynaecologists to the simplified technique adopted as a one stage operation where diversion of the urinary stream is desired.

Three general methods are available for diversion of urine, namely, nephrostomy, cutaneous ureterostomy and uretero-colic anastomosis. Each has its own indications and in this article the author is mainly concerned with the transplantation of ureters into the colon which is the operation of choice in most of the conditions where diversion procedure is indicated.

## HISTORICAL

The idea of such transplantation seems to have suggested itself to surgeons for establishing continence in cases of ectopia vesicae and vesico-vaginal fistula by surgically producing a cloacal condition as it exists in birds. According to Grey Turner it was John Simon (15) a British Surgeon in 1851 who first transplanted the ureter into the lower colon in man. Ever since, surgeons the world over have been attracted by this problem and after numerous experiments have perfected this operation and placed it on a firm basis. However according to Grey Turner (14) the credit is due to Cheput for the idea of the method adopted in the Coffey operation.

In 1896 Maydl is said to have transplanted the wall of the bladder with the ureters into the sigmoid. In 1898 Franklin Martin (9) worked on the problem with experimental animals. In 1906 Moynihan (11) inverted a large part of the bladder into the anterior wall of the rectum. Sir Harold Stiles (13) transplanted ureters in children. Coffey (1) of Portland clarified both the anatomical and surgical problems involved in the operation. In 1911 he reported his first experimental attempts at valve formation by burying the ureter to a short distance in the bowel wall before in-

serting it into the lumen. The ureter was drawn into the bowel through the opening in the mucosa by an anchoring stitch about a centimeter below. This is known as Coffey's technique. Coffey (2) published his second method in which he suggested the use of ureteric catheters which are withdrawn down into the rectum. In this technique both ureters could be transplanted at the same time. In 1930 Coffey (3) published his third method in which the ureter is transplanted in the sub-mucosa of the bowel but not opened into the bowel. A linen or silk transfixion suture was placed through the ureteral wall which finally sloughs off forming a fistula. Only one ureter could be transplanted by this method at a time.

In 1933 Higgins (4) modified Coffey's third technique by burying the ureter in the bowel wall connected with the bladder. He further put transfixion sutures which penetrate the bowel wall and ureteric wall which are tied to a rectal tube which is pulled at after four days and the urine is said to pass freely. The bladder was excised at a later stage after ten days.

In 1933 Winsbury White (16) also implanted the intact ureter sub-mucosally. At the second stage of the operation the ureters are divided  $\frac{1}{2}$  to  $\frac{3}{4}$  inch away from the buried area and implanted into the bowel with an anchoring stitch.

In 1942 Jewett (6) described a new method of ureteral transplantation in two stages. The first stage consists in burying the ureters in the sub-mucosa of the sigmoid. In the second stage an opening is cut through the ureteral and intestinal walls through an electrode inserted through the ureteral stump. He has made certain modifications later.

Henry Wade of Edinburgh who used a modified Coffey-Mayo technique transplanted both the ureters into recto-sigmoid in one stage. He used a wick of catgut inside the ureter to prevent occlusion instead of using catheters.

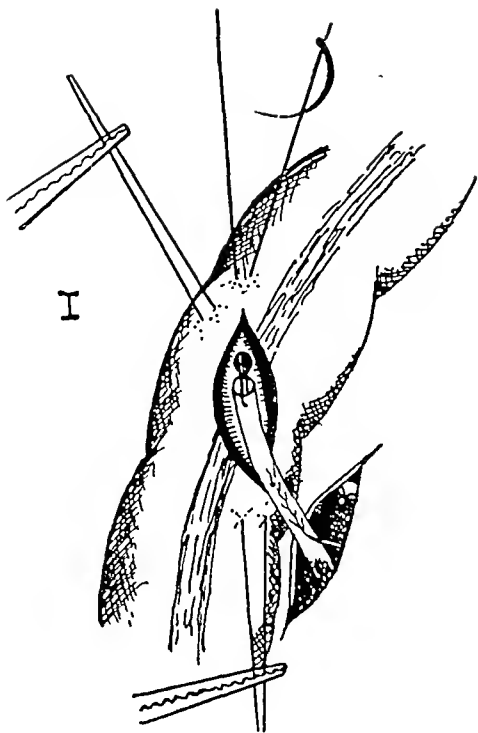


Fig. 1.

Ureter being drawn through an opening in the stoma portion of the submucosal incision and fixed.

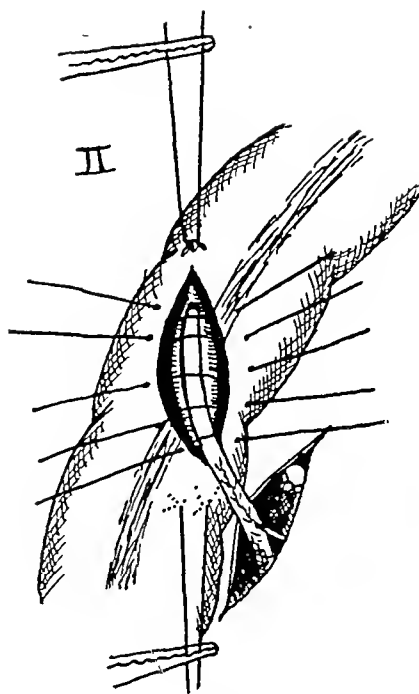


Fig. 2.

Series of sero-muscular sutures superficial to the ureter after fixation of the ureter.

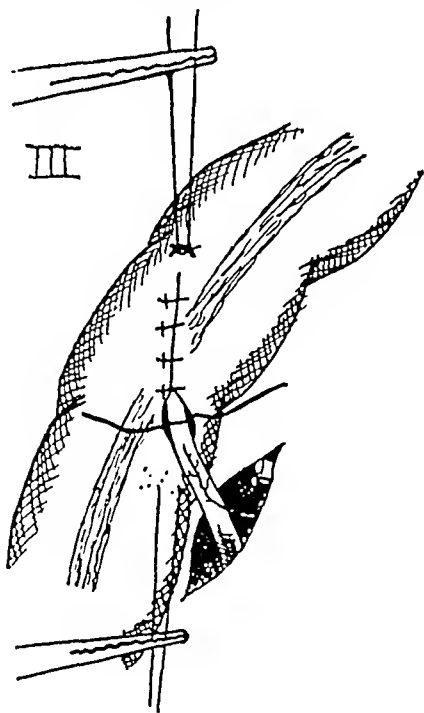


Fig. 3.  
Sutures tied.

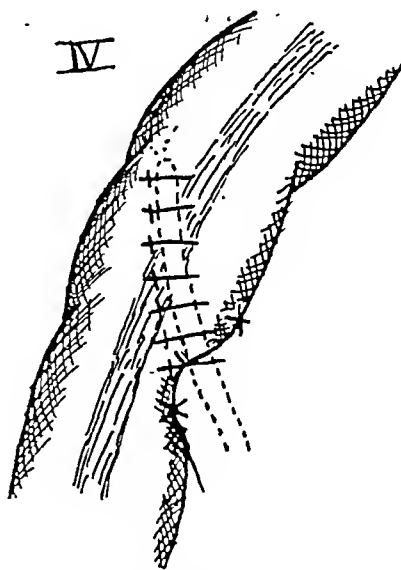


Fig. 4.

Further Lembert sutures and anti margin of the Peritoneal margin brought over the ureter and sutured to the colon.

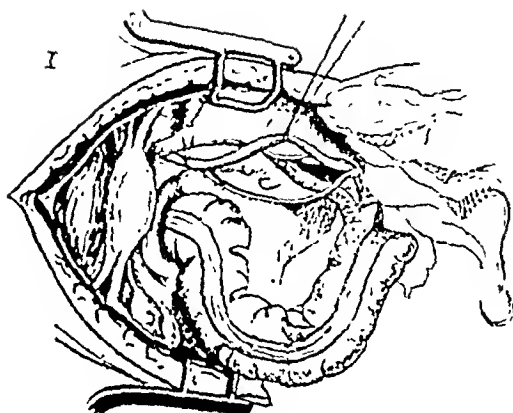


Fig. 5.

Right ureter isolated and lifted. The lower end is ligatured.

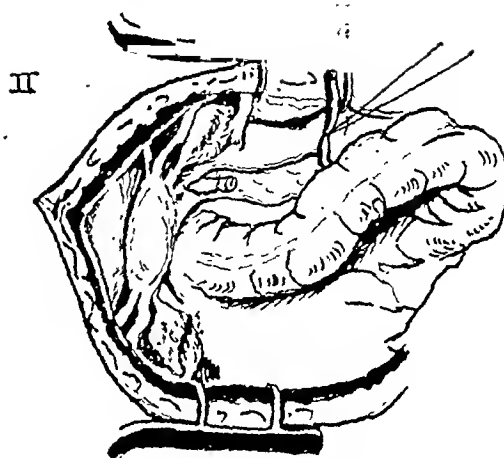


Fig. 6.

Ureter severed as low down as possible after ligature and held up by a loop of catgut.

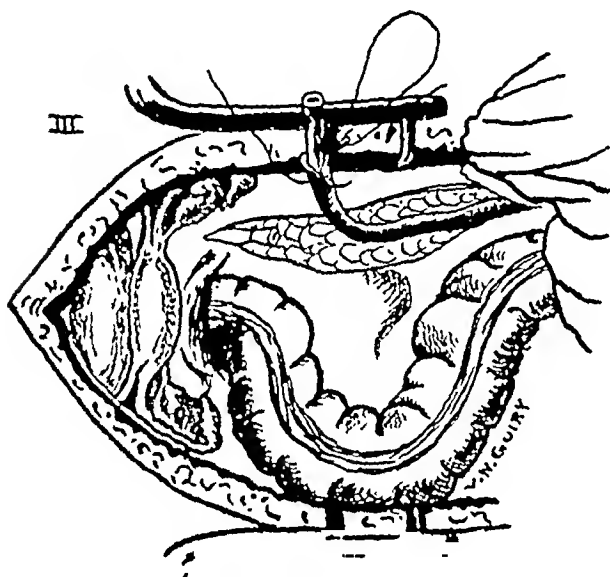


Fig. 7.

Small rubber tube introduced into the ureter which is incised on either side. A transfixing suture of catgut being passed.

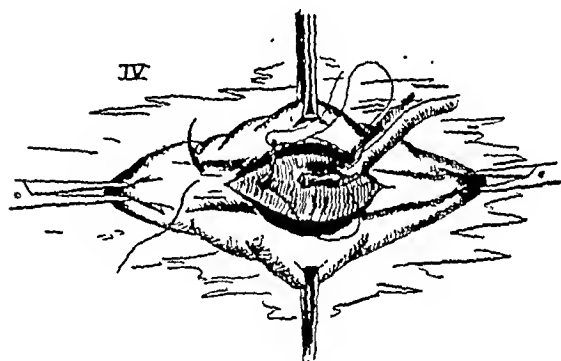


Fig. 8.

Ureter being drawn into the bowel and fixed through an opening in the submucous bed of the recto-sigmoid.

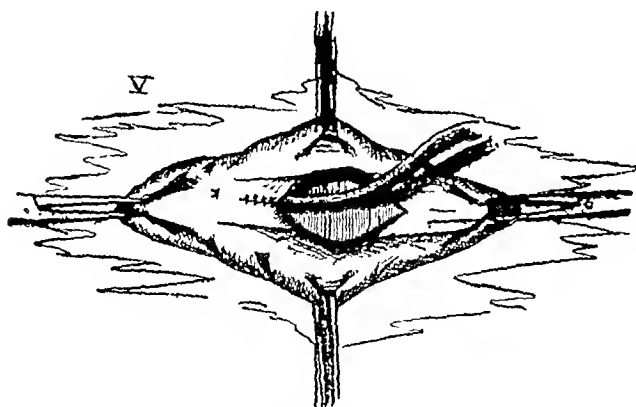


Fig. 9.

Ureter fixed. Sero muscular sutures over the ureter being put in.

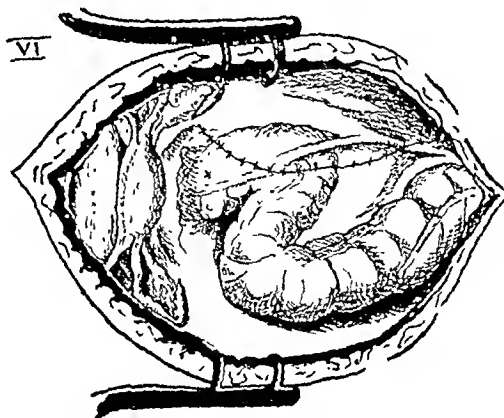


Fig. 10.

Transplantation is complete. Peritoneal opening in the internal wall repaired.

Some surgeons prefer Coffey I technique by the extra-peritoneal route through an extra-peritoneal lower abdominal approach each ureter being exposed in turn and implanted. This can also be done in one or two stages.

In 1947 Yenant Jidigan and William Bicken (7) have reported their simplified technique without catheters, a single stage operation. The author has used both Grey Turner's two stage operation using Mayo Wick (10) (figs. 1 to 4) and modified Coffey II technique (the details are given below) by using short rubber tubes in the ureter (figs. 5 - 10.). Both ureters are transplanted at the same time.

#### INDICATIONS

Transplantation of ureters is indicated in the following conditions:—

- (1) Ectopia vesicae.
- (2) Congenital defects associated with incontinence.
- (3) Vesico-vaginal fistulae which are beyond local repair.
- (4) Injury above the triangular ligament in which urethral repair has failed.
- (5) In cases of carcinoma bladder before total cystectomy.
- (6) Inoperable new growths as a method of short circuit.
- (7) Incurable cystitis.
- (8) Some cases of systolic bladder with tuberculous infection.
- (9) In some rare cases of prostatic obstruction.
- (10) Accidental injuries in pelvic operations.

As the object of the operation is to use the rectum as the urinary reservoir the anal sphincter should be functioning satisfactorily.

In the author's series, a majority of the cases were of vesico-vaginal fistulae which were either unsuitable for local repair or where a local repair had failed. Injury to the bladder may be the result of prolonged and difficult labour necessitating instrumental

delivery. Pressure necroses may be evident on the vagina, sphincter and bladder. When the tissue loss is great and infection has taken place plastic repair is impossible and transplantation of the ureters is one and the only operation that could make the person continent. Patients visit one hospital after the other with a fond hope that some day someone would relieve them of their sufferings both physical, psychological and marital.

#### TECHNIQUE OF THE OPERATION

*Pre-operative treatment*:—It is not an emergency operation. Most of the patients are run down due to infection, loss of sleep and psychological causes. The general health is improved with diet, vitamins, liver extract and blood transfusion wherever indicated. Urinary system requires investigation to estimate the efficiency of the kidneys including urograms and biochemical tests. Urinary infection should be treated. Majority of the cases show uro-genital sepsis and sequele. Many cases showed salpingitis, erosion of cervix and tears of the cervix. Signs of pelvic inflammation, cystitis and pyelitis are common.

*Pre-operative Chemotherapy*:—Sulpha-succidine or phthalylsulphathiazole are of distinct value in this operation. These drugs are slowly absorbed and so can be given several days before and after the operation. They reach a relatively high concentration in the fecal content of the bowel. These drugs reduce very significantly the coliform group of organisms. Many other strains of organisms are also reduced in population. There is also reduction in the bulk of stool which becomes semi-fluid and odourless. Sulpha-succidine is given as follows:—

Initial dose 0.25 gm. per kilo body wt. roughly 12 tablets b.d. and daily (for 5 days) till the day of the operation. Streptomycin is said to be more potent but the author has no experience of its use in these cases. Definitely for the urinary sepsis it is undoubtedly of great value. Diet should be of low residue for a few days before the operation. Patients are invariably given thiamine hydrochloride pre-operatively in view of the sulpha treatment and spinal anaesthesia is used in most cases.

Thirty-six hours before the operation the patient is given a purge, viz., a good dose of cascara; following this the patient is put on a low residue diet. On the morning of the operation, she is given enema till the washings are clear. An injection of 1/6 grain of morphia is given about half an hour before the operation.

**Anaesthesia :—**All cases in this series were operated on under spinal anaesthesia using 1 in 1500 "Nupercaine", 10 to 12 c.c. according to requirements. Ephedrine is invariably given to combat the fall of blood pressure. In a few cases where the operation was slightly prolonged the patients were given inhalation anaesthesia as an adjuvant. The author found the greatest amount of relaxation and peaceful operative field under spinal anaesthesia.

**Operation :—**In cases where the two stages technique was adopted the technique of the Grey Turner-Mayo operation by leaving a catgut wick into the lower end of the ureter was practised. But later, in view of the uncertainty of the patients coming for the second operation and in view of some anxiety during the post-operative period by that operation the one stage technique described below was adopted with excellent results.

**Opening the abdomen and isolating the ureter:—**

A left sub-umbilical paramedian incision is made. The patient is put in the Trendelenberg position after the abdomen is opened. After packing off the intestines the pelvis is explored. The right ureter is first transplanted. It is identified as near the bladder as possible and the peritoneum over the ureter is incised. The ureter is dissected upwards for a distance of three to four inches, care being taken not to injure the periureteric vessels. A ligature is placed at the lower end of the ureter as near the bladder as possible. Then the ureter is cut proximally with a scalpel and is held up either with the aid of a rubber band or catgut loop. Urine will be found coming in jerks from the cut end of the ureter. Bending the ureter to thirty-five to forty-five degrees will stop the flow. The divided peritoneum is

sutured except for an inch near the brim of the pelvis, to be dealt with later. (See Fig. B. Series).

With a fine pair of scissors the ureter is cut on either side of the opening for a distance of a quarter of an inch so that the two halves may be turned up like a cuff if necessary. Fine rubber tubing one inch long and 1/6 to 1/5 of an inch diameter (No. 4 F) is introduced into the lower end of the ureter and retained there with a catgut stitch with a long double thread on one side which is used for drawing the ureter into the bowel and for fixing it there. Alternatively a simple transfixion catgut suture through the ureter and the tube could also be used as the anchoring stitch for the ureter. (See figs. 5 - 10).

**Preparation of the sigmoid :—**Recto-sigmoid region is selected and a transplantation is done in the taeniae-coli zone. The right ureter is transplanted as low down as possible taking into consideration that the obliquity of the ureter is maintained when the patient is erect. The recto-sigmoid is held up with the aid of tissue forceps or stay sutures, and the site of the implantation is held taut. This is incised obliquely for a distance of one inch to one and a half inches to open up the sero-muscular zone. At the distal end of the incision in the bowel a small nick is made to open the bowel which is enough for the ureter to be passed. The nick may be dilated with an artery forceps (blades being opened after passing in).

**Fixation of the ureter in the bowel :—**The two ends of the suture of the lower end of the ureter with a rubber tube in are separately passed through the bowel about 1/4 inch apart so that when the ends are tied the ureter with the tube is pulled up against the inner wall and fixed there in position.

**Fixation of the ureter in the submucous bed of the bowel :—**The muscular wall of the bowel is sutured over the ureter in its submucous bed using a series of interrupted Lembert sutures. Six or seven sutures are sufficient to draw together the incision in the bowel. Further Lembert sutures are put in to cover the anchoring stitch of the ureter. The idea of this is to have a valve

like action so that when the colon is distended the ureter is compressed. This prevents infection of the kidneys. At the point of the emergence of the ureter from the lateral pelvic wall, the upper layer of the peritoneum is drawn over the ureter and sutured to the bowel wall. This concludes the implantation of the right ureter.

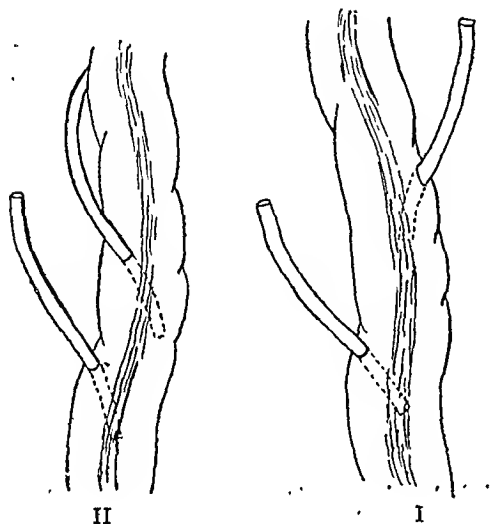


Fig. 11.

Bilateral transplantations on either side of the colon. Left higher than the right.

Fig. 12.

Bilateral transplantations on the right side of the recto-sigmoid. The left ureter drawn through mesocolon and transplanted on the same side as the right.

The left ureter is next implanted in exactly the same manner. The ureter is transplanted into the recto-sigmoid one inch above the right ureter (fig. 11). The ureter is not brought over to the right side through mesocolon, but transplanted only on the left side of the mesocolon. The question of bringing the ureter through the mesocolon arises only when it is proposed to transplant the ureter higher up in the sigmoid, in which case the sigmoid has to be fixed to the posterior abdominal wall (fig. 12). The abdominal cavity is cleared of clots, the appendix and other pelvic viscera examined and attended to. After pencillin toilet abdomen is closed in layers without drainage.

**Draining the rectum:**—A self-retaining catheter is introduced into the rectum, which is connected to the bottle to measure the quantity of urine drained in twenty-four hours. This also prevents accumulation of a poodle in the rectum which might encourage ascending infection.

**Post-operative treatment:**—Patients are kept in Fowler's position for twelve hours after the operation. Kidney function is watched. The patient is encouraged to take fluids. The fluid balance is maintained. If necessary intravenous dextrose (5 to 10% solution) is given. The total quantity of intake both by mouth and the parenteral route should be about 4500 c.c. or 150 ozs. per day. If the quantity of the urine is less than 600 c.c. the patient is given a pint of sodium sulphate (4.3%) with very good results. On the fourth day the rectal catheter is removed. The patient is put on non-residue fluid diet from the second day till the tenth day. Sutures are removed on the ninth day.

In the post-operative period sulphadiazine drugs are used from the time the patient can take the stuff and continued for ten days.

**Immediate complications:**—

- (1) Anuria or oliguria.
- (2) Lung complications.
- (3) Peritonitis.
- (4) Pyelitis and ascending renal infection.
- (5) Extra-peritoneal inflammation.
- (6) Rectal irritation.

In this series of cases there were only complications of a few bouts of pyrexia in a few cases indicating kidney infection which settled down with sulphadiazine and mandelic acid treatment alternatively. In some cases there was rectal irritation and diarrhoea. This irritation is due to urinary products and it settles down in two weeks. In the first three or four weeks after the operation the patient passes urine frequently—every three to four hours during the day and six to seven hours during the night. In the beginning the patients complain of diarrhoea but this also settles down. Later the urine and the faeces are voided sepa-

rately in most of the cases. Sphincter exercises are given before and after the operation.

**Mortality :—**In the author's series there was one hospital mortality (case of chronic cystitis due to inter-current jaundice). All the patients were selected cases. In malignant disease of bladder and ectopia vesica the mortality is reported to vary from 5 to 10%.

**Advantages of one stage operation :—**In the earlier cases of the series two stage operations were adopted. It was found to be disadvantageous to the patients in that they had to undergo two operations. Secondly, patients were unwilling to stay on for a longer time in the hospital. Thirdly, on opening the abdomen a second time, adhesions in the pelvis made it a little difficult to transplant the left ureter at the ideal place. In the single stage operation where the small rubber tubes are introduced into the ureter there were very few complications.

**Follow up and prognosis :—**All the patients stayed in the hospital for about eight to ten weeks after the operation. Only when they were perfectly ambulant were they discharged with instructions to report at the hospital if there were any complications or difficulty.

**Details of the thirty transplantation of ureters of the present series :—**

Incontinence of urine (A case of congenital absence of vagina) ..	2 (In two stages)
Vesico vaginal fistula ..	25 (see infra)
Chronic cystitis ..	2 (One stage modified Coffey II technique).
	Death due to cholangitis and jaundice.

Accidental injury during hysterectomy for fibroids ..	1
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Total number of Trans-  
plantations .. 30

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**Details of cases of Vesico-vaginal Fistula :—**

One stage (Modified Coffey II technique six cases) ..	12
Two stage (Grey Turner's Technique, five cases) ..	10
Patients who had only first stage but either did not come for the second stage or had the second stage elsewhere ..	3
	25

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Mortality was nil.

During 1946 and 1947 about seventy-five transplantation of ureter operations were performed in the Madras Government Hospitals, of which twenty-four (32%) had been done by the author.

In the Mayo clinic out of Sixty-six patients eighteen were dead at the time of report in 1926. Out of the forty-eight living only twenty-nine reported on their condition. About twenty-five of these were satisfied with their results. Two had poor control of urine. One was incontinent. One had irritation of rectum with diarrhoea. G. G. Smith (12) reported on the late results of ureteroenterostomy done by him during 1930 to 1946. He had operated on 60 patients. 50 of them had bilateral transplantations. In sixteen only one ureter was treated. The ureter which was not transplanted to the bowel was ligated in six, transplanted on the skin in eight and not operated upon in two. The total number of transplantations were 116. In forty-seven patients for carcinoma of the bladder and two for carcinoma of the cervix, there were twelve hospital deaths and fourteen deaths from recurrence of cancer. In addition there were eight post-hospital deaths due to pyelonephritis. In seventeen patients operated on for non-malignant conditions there were no hospital deaths and there was only one post-hospital death due to pyelonephritis. Out of twenty-four patients now alive in that series seventeen had satisfactory renal function, three showed signs of renal failure and four required skin ureterostomy. He further states that in at least four of the patients who died of pyelonephritis, renal drainage by nephrostomy or

ureterostomy would have prolonged life. He recommends that cases who had transplantation of the ureter should be followed up for renal function and excretory urograms taken at least once a year to prolong their lives by operative interference such as nephrostomy and skin ureterostomy if evidence of renal failure is found. Lakhani (8) gives average mortality of 30-35% in uretric transplantations in cancer of the bladder.

The follow up of cases is difficult unless there is a suitable organisation to trace the patients.

### Summary and Conclusions.

1. The development of the technique of transplantation of ureter is described.

2. Indications for the operation are mentioned. In the author's series vesico-vaginal fistula formed the main indication.

3. Modified Coffey II one stage technique was employed by the author in seven cases and Grey Turner (Mayo wick) two stage technique in the other cases. The former technique is described. One stage technique in cases of vesico-vaginal fistula is found very promising. Mortality rates of the one stage technique including its indications are mentioned. The mortality rate in this series is about 6%.

5. Prognosis and follow up of cases after transplantations are reviewed.

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# CERTAIN ASPECTS OF REPAIR OF FACIAL DEFECTS

*With reference to Prosthetic Appliances*

by MURARIMOHAN MUKHERJI, Calcutta.

Defects of the face may be various of types e. g.:

1. Superficial defect involving skin and fascia.

2. Deeper defects or full thickness defects involving skin, muscles and mucous membrane.

3. Deeper defects associated with bony loss i.e., contour defects.

The disfigurement is really serious when there is full thickness defect with some amount of contour defect too. These cases lead a miserable life with saliva dribbling all the time. They become unsocial and invalid. The repair of these defects is essential not only for mechanical purposes like chewing and eating but also for the mental improvement of the condition of these patients. The question of appearance in relation to marriage in the case of the females is also of some importance. Besides actually closing the gaps, there is, therefore, the very important point of correcting asymmetry and contour defects in the cheek and face. The normal curvatures and dimples of the cheek are so nice, gradual and rounded that human efforts to reconstruct the same may only attempt to compete with nature but can never be fully successful.

*Superficial defects.*—These are easy to repair. After excision of the scar the gap can be filled up in one or other of the following ways:

1. Simple undermining and suturing if the gap is not big, say not more than  $\frac{1}{2}$ " or  $\frac{3}{4}$ " in diameter.

2. Flap cutting—rotation or advancement flaps when the gap is bigger, say 1" or a little more.

3. Thiersch graft if the gap is fairly big and the scar is supple and not fixed to deeper structures. Split skin graft ( $\frac{3}{4}$ " thickness) is best as it prevents secondary scar formation

under the graft. Wolfe's graft is good for these cases but there is uncertainty in the taking of the graft.

4. Pedicle flaps—last and most important method for unhealthy, atrophic and fixed scars of wide area. Disadvantages of this method are two, namely:

(i) The matching of colour is defective.

(ii) The thickness of the pedicle may cause asymmetry. (But this thickness is an advantage in cases who have a depressed scar).

But in many cases this is the only method possible for the repair.

Of all the above methods the "flap cutting" (No. 2) is best as the colour matching is perfect and the linear scars of the sutures are negligible. But this method cannot be applied for cases with a big gap as the tension of the flaps may deform the normal corners and curves of the face. Pedicle flaps are the best when the destruction of soft tissues under the skin has made moderately deep defects requiring some fat to fill up the depression. Pedicle flaps are usually brought from the forehead, neck or abdomen by flap graft or by tube grafts. Direct flaps from the medial side of arm or forearm are also quite useful. The skin of these flaps match the colour of the face. It has very little hair. Easy procedure and the saving of time are two more advantages to its credit. See figures 2-5 & 6-7.

*Deeper defects or full thickness defects.*—This is the most common defect in my series and 5 of my cases were due to cancrum oris after kala-azar or typhoid.

TABLE 1.

Showing the nature of the defects with their causes.

Total number of cases	Full thickness defect.	Cases due to cancrum oris.	Cases due to Malignancy.	Cases due to injury.
6	6	5	1	0

N.B. Superficial defects are not included here.

These cases have the following special features :

1. Usually the general health is bad for a long time after such illnesses.
2. The holes in the cheek are of varying sizes varying from  $\frac{1}{2}$ " to  $1\frac{1}{2}$ " in diameter.
3. Besides loss of skin and mucous membrane there is loss of fat and muscles resulting in defect of the contour of the cheek. There may be loss of portions of cheek bones too.
4. The margins of the opening are scarred and fixed to the jaw bones in most cases.
5. Teeth are usually bad and septic.
6. The mandible is fixed in most cases so that patients cannot open their mouths. and, because, in this country many patients come for treatment long after the incidence of the disease, the fixed mandible does not develop properly and the face becomes more defective in the contour of the chin.

So these cases require a considerable amount of preliminary treatment before they are fit for plastic repair of the cheek.

1. The general health has to be improved by curing the kala-azar and giving them high protein and vitamin-containing diets.

2. The mouth cavity has to be made clean by extracting all septic teeth and by attending to the alveolar margins if there is any osteomyelitis.

3. The fixed mandible should be opened by wooden screw gags or by Esmarch's operation. This procedure will help the patient in taking his meals and will help the surgeon a lot during anaesthesia and operation.

When the patient's general and local condition are improved in the above ways, he will be fit for operation on the cheek. The repair of the defect in the cheek may be done in various ways and many methods have been advocated in the different books on plastic surgery. But this is a new branch of the science and is still growing very fast. Moreover the subject is so diverse that no one method can be made to fit all. The following are the salient points for repair of a full thickness defect of the cheek:

1. The defect must be repaired by a graft which will have both surfaces covered with epithelium either skin or mucous membrane.

2. The graft must have the necessary amount of fat and muscles to remedy the contour defect.

3. The graft must take properly i.e., without any sloughing of the margins.

4. The time factor should also be kept in mind as the less time it requires to cure a case the better it is both for the patient and the hospital, especially when the hospital accommodation of this country is still very meagre.

These defects can be classified in the following ways so far as the different methods of treatment are concerned:

1. If the gap be less than  $\frac{1}{2}$ " diameter and if the margin of the scar is healthy, then simple closure of mucous membrane and skin by undermining both can be done easily. The only point to take care is that the two suture lines do not coincide with each other.

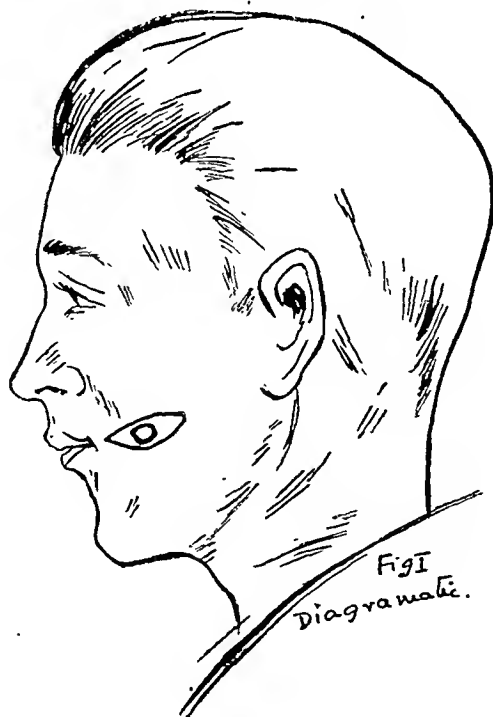


Fig 1.

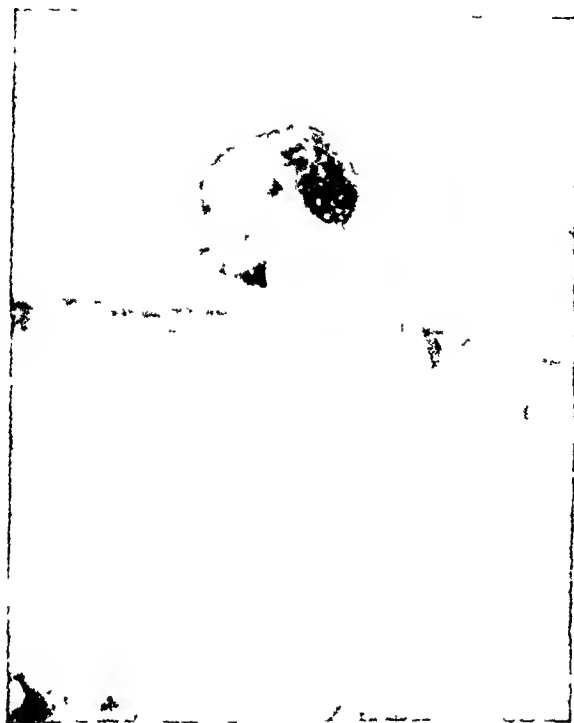


Fig. 2  
Showing the gap. (pre-operative)

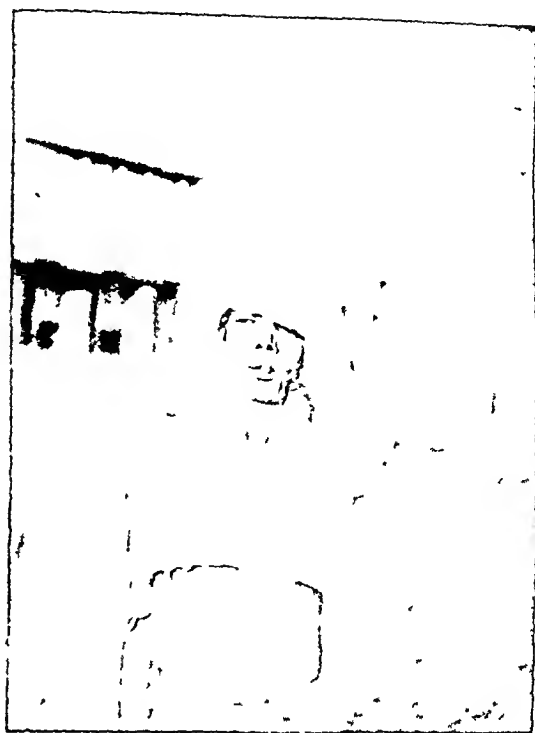


Fig. 3.  
Showing flap graft from arm.

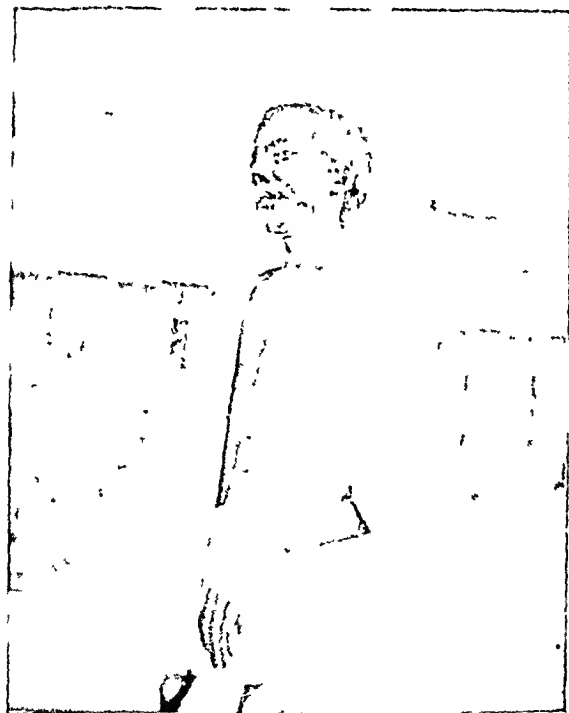


Fig. 4  
Note: the graft has taken.

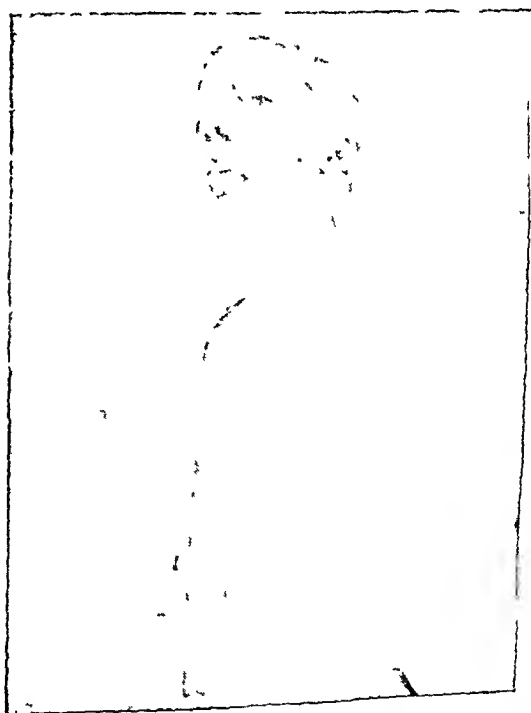


Fig. 5.  
To show that there is no difficulty in opening the mouth.



Fig 6.

Example—Case No. 1 B. Pal, H. M. 34 was admitted in the Campbell Hospital with a small opening ( $1/3$ " diameter) in the left cheek. He had it as a result of cancrum oris 5 years back

Operation—the mucous membrane was incised along the margin of the opening and was undermined. It was sutured keeping the knot inside the mouth. Then an elliptical incision was made as shown in the fig 1, and the scarred skin was removed from the margin of the incision, the edges of the wound were opposed by five silkworm gut sutures. Patient went home cured in 10 days

2 If the gap be between  $1/2$ " and  $3/4$ " a modified form of flap graft gives a very good result. The opening is closed on the mucous membrane side by taking  $1/2$ " margin of the skin (part of which may be scarred a bit) all round the opening and suturing it with catgut keeping the knot inside the mouth. This layer acts as the inner mucous lining. Then a direct flap graft is taken from the medial side of the arm. This flap covers the defect on the skin. The necessary amount of fat can be taken along with the graft. The colour of the skin of the medial side of the arm is almost same as that of the face. And



Fig 7.

as the graft is made by direct flap the usual discolouration of the tube graft is avoided. This graft takes within 3 weeks and the wound in the cheek and arm take another 10 to 15 days to heal up. So the maximum time required should be 6 weeks approximately. The figures of case No. II & V show this method of repair in detail. Case No. II (Figs. 2-5) came with an opening in the cheek of  $3/4$ " diameter. He was treated with the above method and was cured in 6 weeks time. The surface irregularity of the grafted skin will disappear in another few weeks.

Case No V (Figs 6-7). Dr. B. C. was finally repaired by this method as after the first repair the gap became much smaller and the time factor came to the forefront. The hairy portion of the forearm was taken as it would give rise to some beard in the cheek. The condition of the skin all round was so unhealthy that a small slit on the posterior aspect could not be closed before he left hospital. The slit, however was almost closed after a few months without any other treatment. The contour defect could not be repaired in this case due to loss of the first graft. Replacing an artificial lower jaw with teeth was not attempted as the irritation from the prosthesis may start the malignant ulcer. Figure 6

3. If the defects are bigger than  $\frac{3}{4}$ " diameter the repair can be done by various means of pedicled flap and tube graft, e.g.:—

(a) Two pedicled grafts; one from the neck with skin side inside replacing mucous membrane; one from the forehead to cover the external aspect of the first graft. This is an age old method and is described in many books.

(b) Doubled portion of a tube pedicled flap may be utilised to repair such defects.

(c) A pedicled flap with Thiersch's graft on the under surface to act as mucous membrane has given me a very good result in fairly short lengths of time. I think this method should be the best of the above ones.

The two pedicled flap method leaves behind a scar in the forehead and neck and this is not at all satisfactory specially for female patients. Then again the flap from forehead has to have a long pedicle and hence there is a great chance of loss of vascularity and consequent sloughing of the end and margins of the flap. I have seen these flaps failing to cover up a gap due to loss of vascularity. Figure 19 shows a case whose nose was repaired by such a flap and one can see that not only the flap has not taken but she has a very bad scar on the forehead.

*Doubled up tube grafts.*—This method has the following disadvantages:

- (a) The tube has to be unusually thick if it is to be made wide on flat section and this thickness may make an undue prominence in the cheek.
- (b) Hair will grow from the inner surface of the graft inside the mouth.
- (c) It is impracticable to make a suitably wide tube which will cover a big gap in the cheek say  $1\frac{1}{2}$ " or 2" diameter. I have attempted to make wider tubes by rolling the skin on a big sized rubber tube but the major portion of the margins sloughed off. So in such cases one will have to construct a rectangular folded flap graft instead of a tube graft. But even then the problem of hair growing inside the cheek is not solved.

So I have resorted to the third method and that is a *pedicled flap graft with Thiersch's graft* on the raw side to act as mucous membrane.

### PROCEDURE.

A skin flap of required breadth and thickness is raised on the abdominal wall or infraclavicular region. Depending on the loss of the contour, this flap may have only skin, skin and subcutaneous tissue or skin, subcutaneous fat and deeper muscles too so that the increased depth of the flap will assist in filling up the gap. This flap is delayed for 15 days giving the underface time to vascularize and granulate all through.

Then a suitable sized Thiersch's graft is spread over a stent's composition with raw surface outwards. This mould is then placed under the flap of skin raised for the purpose. The Thiersch's graft will take in 15 days time and then the pedicled flap is transferred directly to the face from the infraclavicular area or via the fore-arm if the same is taken from abdominal wall, e.g. (Figs. 9, 10, 13, 17, etc.) In transferring these flaps one should take particular care about their vascular supply. A pedicle clamp should be applied slowly and gradually for 2 to 4 days to the side which will be resected to ensure that the vascular supply from the other side will be sufficient to maintain the nutrition. This little procedure especially when the last pedicle is cut after one end is fixed to the margin of the facial gap (which may not be normally vascular) may save the beauty and efficiency of many operations. Example of one such failure is in case No. V. His contour repair was perfect in the first operation but the flap lost vascularity and the distal margin sloughed off giving rise to a smaller full thickness defect again. The contour defect was evident again due to loss of fat.

The following are the cases who had full thickness and contour defects of the cheek repaired by pedicled flaps.

Case III. (Fig. 8 - 10).—Miss B. H. F. 10 years had a perforation in the cheek 6 years back due to cancerum oris following kala-azar. The gap was of about 1" diameter. It was repaired by pedicled flap graft lined by Thiersch's graft from abdominal wall. Time taken was about  $3\frac{1}{2}$  months. The contour defect was not filled up perfectly.



Fig. 8.

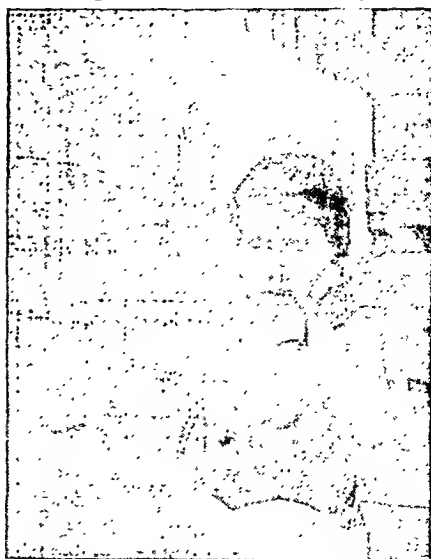


Fig. 9.

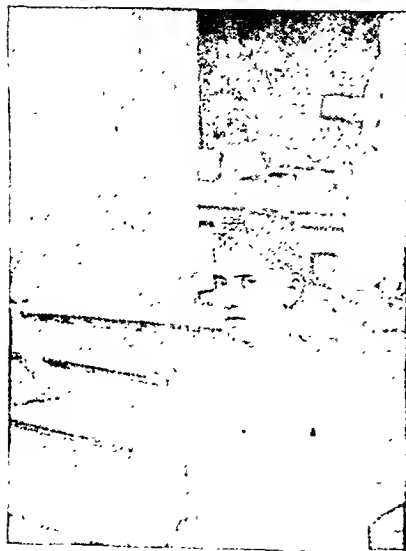


Fig. 10.



Fig. 11.



Fig. 12.



Fig. 13.



Fig. 14.



Fig. 15.



Fig. 16.



Fig. 17,

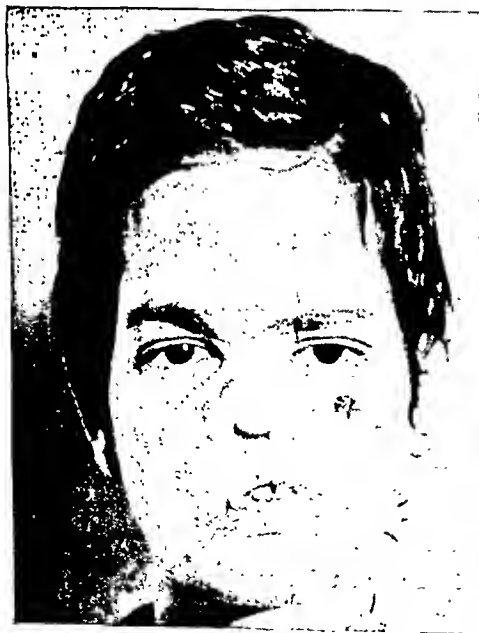


Fig. 18.



Fig. 19.





Fig. 20.

Case IV. (Fig. 11 - 15).—Mr. R. M. M. 14 years had osteomyelitis of left maxilla with destruction of a big area of the left side of the cheek. It was repaired by a thick pedicle flap containing the whole of the subcutaneous fat and some muscles from the abdominal wall. The contour defect was fairly well repaired as evident from figure 15. He had fixation of mandible as evident from fig. 11. An Esmarch's operation was done on left side and he could open the mouth as shown in fig. 14. The left eye being lost and not replaced by an artificial eye for a long time, the defect of the eye could not be cured completely though an artificial eye with a plastic eye ball was fitted as shown in Fig. 14.

Case V. (Fig. 16 - 17).—Dr. B. C. H. M. 49 had carcinoma of the left cheek and a hemi resection of the mandible was done. The wound gave way and a big gap of about 2" diameter resulted (due probably to the destructive effects of radium and deep x-ray applied previously). 6 months' time was given for the cheek wound to heal up completely and for the effects of radium to pass off. Then a pedicled flap graft lined by razor graft was lifted from infraclavicular area. The flap contained the whole of the subcutaneous fat and the pectoral muscle as the contour defect was severe in this case. The pedicle was fixed directly to the cheek and the gap repaired with perfect cure of contour a month later. Unfortunately the distal margin of the flap sloughed off and the whole operation was spoiled. Since this

operation I have started using clamps to the pedicle which is going to be cut to ensure a good blood supply from the other side. There developed a small gap again and this had to be repaired by a direct flap graft from the forearm as shown in figures 6 & 7.

### Prosthesis.

Case No. VI (Fig. 18 - 20).—The repair of contour defects of the face is really a difficult affair and every one will admit that it can never be done perfectly well so that the repaired side will look exactly the same as the normal one. Next to this difficult job is the construction of nose or ear. Many surgeons have tried this with more or less success. But no one has ever been able to construct a nose which will have rounded curves like the normal one. I think it is humanly impossible to construct an ala which has both anteroposterior and lateral curves. One such case was attempted by us for one year and no less than 8 operations were done on her. The result is shown in Figure 18. Then decision was made to have a prosthesis made for her.

Procedure.—The nose was constructed with plasticine in the presence of her father so that her former nose could be imitated. Then a die was made in plaster of Paris. This whole procedure was done by Mr. N. C. Pal of Calcutta. Then the definitive nose with some portion of the upper lip and cheek was made from colourless plastic called "Kallodent" (I.C.I.). This nose was fitted on to a goggles for support. The margins were levelled so that there is a very close opposition with the cheek. Then, the prosthesis was coloured matching the complexion of the patient considering the fact that her face was full of scars at the moment the colouring was done in certain irregular ways to match with the disfigured face. The lip margins were reddened and the margins of the nostrils were blackened. This prosthesis was so nice that it could not be made out at a distance of about 20 ft. in the broad day light. Figure No. 19 shows the scarred face with no nose, the prosthesis held in the hand and figure 20 with the prosthesis applied.

I like to mention a few points in the construction of a prosthesis which differ from the usual teaching:

1. There is no need of taking a negative mould of the face and of making a plaster figure representing the face provided a good artist can make a positive plasticine figure constructing usual organ and at the same time repairing a contour defect present. This figure can be verified by one of the patient's relations who saw her before the defect or by her former photographs. This will save a considerable amount of time, energy and money.

2. The prosthesis should be made of plastics as it is unbreakable and the edges can be bevelled to very thin plates so that apposition becomes perfect.

3. The prosthesis should be made of non-coloured plastic as whatever mixture of colour is made matching the complexion of the patient the prosthesis will be worse than when non-coloured one is painted properly. If one looks carefully he will find that the colour of different parts of the nose is not exactly same. Every region of the human body has a different shade of colour. The alae of the nose are different from the tip of the nose. Then again if the prosthesis com-

prises of some other part than the nose or ear the complexion of these parts can never be the same. These finer shades can be well done by painting on a white base.

4. Fitting of the prosthesis should be done according to the conditions prevalent in the local parts of the patient and according to suitability of appliances like spectacles, nose-ring or hair clips.

I pay my sincerest thanks to Dr. D. C. Chakravarty, Superintendent, Medical College Hospital and to Dr. A. K. Datta Gupta, Superintendent, Campbell Hospital for allowing me to publish the case records. I am really grateful to Dr. P. Chatterji, Professor of Surgery, Medical College, for allowing me to work under him.

# REVIEW OF RECENT PROGRESS

## REVIEW OF PROGRESS IN PSYCHO-SURGERY

*by B. N. BALAKRISHNA RAO, Gwalior.*

Psycho-surgery first thought of by Prof. Egaz Moniz in 1936 has shown great stride in its development and application in recent years. The application of the principles of leucotomy has developed in a variety of ways totally unthought of by the originator. Needless to say that this branch of surgery has been of great value to the surgeon, psychiatrist, physiologist and physician.

In the early evolution of this treatment, many were hostile but advancing years of experience has lessened the degree of hostility. On the other hand, the enthusiastic results claimed in the early stages of this treatment has not been borne out by later check up and review.

An interesting off-shoot of this technique of treatment of mental disorders has been the greater appreciation of the essential functions of the frontal lobe. Another interesting and useful application of the technique is its application in a variety of disorders e.g. for intractable pain (Freeman), for epilepsy (Baretto), for Alzheimer's disease (Lopez Ibor), etc.

Leucotomy has undergone a fairly critical review, and is getting more popular both with psychiatrists and surgeons all over the world as evinced by the large number of published papers in many countries, and in this brief note it is impossible to review the mass of literature; only a few salient features and the work done at the first international conference of psycho-surgeons held in Lisbon in August 1948 under the presidentship of Prof. Moniz and Dr. Freeman will be mentioned.

After leucotomy as first described by Moniz and Lima, a large number of workers have modified the operation. Freeman and Watts have approached the frontal lobe from the lateral side of the skull, and of late the superior approach 2 cms. away from the middle line appears to have become popular. Open operations which were at one time

popular have not gained much ground. The best method of approach, whether from the superior or lateral aspect is still a moot point. Flamberti, Freeman and Watts have advocated an approach through the roof of the orbit at a point where the bone is thin and could easily be punctured. This trans-orbital approach has been performed largely in the U.S.A., Italy and Brazil.

The technique of the transorbital pre-frontal leucotomy is simple. The anaesthetic employed is the unconscious phase of the post-electric convulsive shock. The instrument consists of a special leucotome which is in the form of a long nail 17 cms. long, with a head and a collar at a distance of 13 cms. from the point. It is graduated from the tip to the collar in centimetres. The distal 13 cms. have a diameter of 0.5 cm., and the proximal portion 0.8 cm., and the point is sufficiently blunt not to break on hammering. After the patient has been given a few convulsive shocks and the conjunctival reflex is lost, the instrument is pushed through the upper fornix of the conjunctiva at its middle, and a depression in the orbital plate felt for with the tip of the leucotome. The shaft of the leucotome is held parallel to the contour of the nose, and hammered by light blows to the depth showing 4 cms., and the instrument hinging at the point of entry into the bone, is moved through an arc of 45 degrees. Then it is hammered again to a depth of 7 cms. and moved through an arc of 15-20 degrees. The movement of the instrument while cutting should be parallel to the coronal plane. The instrument is withdrawn and the procedure repeated on the opposite side. A small subconjunctival haematoma that might form is of no moment, and is absorbed in a few days. The operative procedure seldom exceeds two to three minutes for its performance and the patient is conscious in ten to fifteen minutes. Often he is in a condition to walk, though a little unsteady and disoriented. This transorbital approach has the great drawback that the

instrument passes through the fornix of the conjunctiva, an area difficult to sterilise, and the risk of meningitis is always present. Published results however have been quite free from this complication. However, it is still on trial, and has not been accepted by many psycho-surgeons as an improvement on the older methods, though many psychiatrists have favoured it on account of its simplicity and rapidity of performance.

A number of workers (Le Beau, Getano de Barres, Poole, Heath and others) have, after studying changes in the brain in leucotomised patients, and correlating their results with observations in animal experiments and study of cranial war wounds, suggested that bilateral removal of a relatively small specific area from the cortex of each frontal lobe might prove beneficial in the treatment of psychoses after psycho-therapy and shock treatment had failed. In all of them when Broadman's areas 9 and 10 were removed, a post-operative change in their psychotic behaviour was noticed. Results of this operation of 'Topectomy' have been encouraging, but more extensive trials are necessary before its value could be assessed. Poole and Heath's results are promising. In 34 patients, who had undergone topectomy of Broadman's areas 9 and 10, there were no operative fatalities or significant complications. There have been no convulsive seizures, urinary incontinence has rarely occurred and has never lasted for more than 10 days, intellect has not been impaired, and the I.Q. rating has generally improved. Before operation, all but 4 in the entire series had been institutionalised. 22 of the 34 patients have been followed for longer than three months. Only three of this group have been institutionalised, and most are functioning at pre-psychotic occupational levels.

A further modification of the principle of prefrontal leucotomy has been used in the interference of the fronto-thalamic interrelationships by producing small lesions in the dorsomedian nucleus of the thalamus. This operation of 'Thalamotomy' has been practised in the United States, and encouraging results have been claimed by Wycis and Spiegel from Philadelphia, and by Scoville of Hartford, Conn. By means of a stereo-

encephalotome of their design, electrocoagulation of portions of the thalamus was performed with an insulated electrode producing four or five lesions of 3 mm. diameter each in the dorsomedian nucleus of the thalamus. A favourable result has been claimed particularly regarding nervous tension, anxiety, depression, irritability, agitation, hallucinations and compulsions. "Except for one case, no impairment of intelligence was demonstrable in a series of 8 patients. Such sequelae of prefrontal lobotomy as epileptiform convulsions, distractibility, childishness, facetiousness, lack of tact or discipline were absent in our material." These studies are being continued.

Pimenta, Mario Yahn and Sette Jr. have performed parietal leucotomy. They argued that the explanation advanced by Freeman and Watts concerning the antagonism between the prefrontal and thalamic functions did not appear to be satisfactory. Incisions, were therefore carried out in an effort to sever the superior longitudinal tract close to the ventricle. The operation was carried out in 25 cases, of whom 17 had already been subjected to prefrontal leucotomy. The results, on the whole, were inferior, and parietal leucotomy according to the authors was found to be ineffective in the treatment of psychoses.

A great deal of attention has been paid to the site of section of fibres in prefrontal leucotomy. It is generally agreed that the more posterior the cut, the more extensive is the effect and very often leads to gross personality changes. A. Meyer with T. Mc Hardy in a clinico-anatomical investigation of 40 cases have shown that unfavourable sequelae followed a posterior cut much more often than with an anterior. They define posterior cut as one involving the posterior half of the orbital region, the striatum, the premotor region (Broadman's areas 6 and 44), the region of the external capsule or any combination of these. The personality change tended to be most severe when the posterior lesion was most wide spread. The authors conclude that personality change does not depend upon but is amplified by, damage to the posterior region of the frontal lobe. The authors stress this,

since it is at variance with Hebb's contention that personality is not affected by almost complete removal of both prefrontal regions. Again, such symptoms as general restlessness, vasomotor and trophic changes, nutritional deficiency, hyperpyrexia and respiratory disturbances were all associated with posterior cuts.

The selection of suitable mental cases has always been a moot question. It is agreed that better results could be obtained by careful selection of cases. Schizophrenics with good pre-psychotic adjustment, abrupt onset, and good residual integration of personality did best, in accord with universal experience. Age has no definite effect on the results. Great stress has been laid on the selection and evaluation of results on standardised tests e.g. Robinson deliberation test, Porteus maze, Babcock levy, etc. As it is possible for changes to occur even as late as two years after operation, careful after-treatment and rehabilitation is stressed.

Leucotomy has been applied to cases other than of mental disorders. They are notably for cases of intractable pain especially of facial neuralgia, post-herpetic neuritis,

phantom limb, and painful carcinomatosis which is inoperable. Busch of Copenhagen reports very encouraging results in such cases. (Our experience of two cases for inoperable carcinoma associated with intractable pain uncontrolled by large doses of morphia has been most gratifying.—*Author.*) Velasco of Mexico is of opinion that a partial section of the fronto-thalamic radiation in the lower quadrant is enough, and gives the necessary relief of pain. This aspect of development of leucotomy is of great significance, especially to those who have to manage addicts to morphia necessitated by intractable pain.

Attempts have been made to treat Parkinsonism by a promoter leucotomy. The number of cases, and the period of observation does not warrant any expression of opinion.

In conclusion, it is most gratifying to learn that the great savant Prof. Egaz Moniz who introduced many outstanding procedures in neurology like arteriography, etc., and the founder of the branch of psychosurgery, has been awarded the Nobel Prize for 1949 for outstanding contribution to the happiness of mankind.

## CASES & COMMENTS

### A CASE OF HAEMORRHAGIC CYST OF THE SPLEEN

by A. N. SUBBARAMAN, Madras.

Splenic cysts are rare and their pathology is sometimes obscure. The number of cases of different types of cysts in the spleen reported in the literature is very small. Among them, the haemorrhagic cyst occupies a prominent place and accounts for about 80% of the total cysts. They are generally traumatic in origin, the trauma being usually preceded by enlargement of the spleen, commonly due to malaria. Next comes the hydatid cyst, 3% of all hydatid infections occurring in the spleen. In the General Hospital,

three fingers breadth below the costal margin. There was a globular cystic swelling about 8 inches in diameter which moved with respiration. The upper limit of the tumour could not be felt. The lower border of the tumour was felt well just above the umbilicus. The swelling did not extend to the loins. No ballotment was elicited.

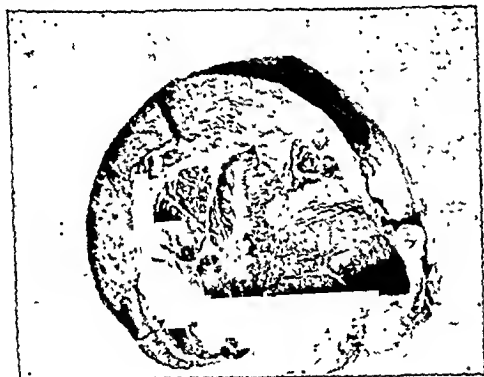


Fig. 1.

Splenic cystic—the cystic is seen on the visceral surface and has a definite capsule. Thickened trabeculae are seen in the interior of the cyst.

Madras, there were only 7 cases of splenic cysts during the last 20 years. With one exception—a polycystic spleen and kidneys discovered post mortem—they were all haemorrhagic cysts.

#### CASE-REPORT.

Miss K. S. A., 17 years, a student in a local High School, was admitted to the General Hospital on 6-6-1949 for a swelling in the upper abdomen of 2 years' duration. She gave a history of malarial fever 6 years ago. The present complaint started with discomfort after food; after a few months she noticed a small swelling over the upper abdomen, which slowly increased to the size of a mango. Later she began to experience breathlessness after food. She had no vomiting. She was a vegetarian. There was no history of injury to the abdomen.

On admission, her general condition was good. The liver was not palpable; the spleen was felt

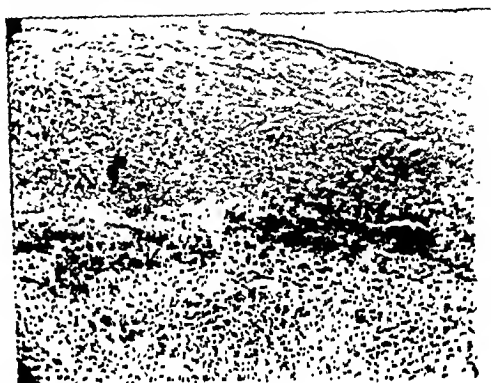


Fig. 2.

Capsule of the cyst formed by fibrous tissue and splenic pulp.

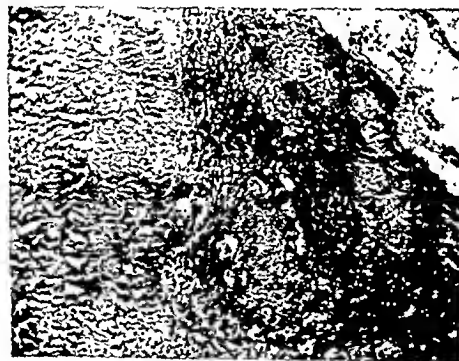


Fig. 3.

Dense fibrous tissue and organising blood clot—section taken from the thickest part of the capsule.

The following investigations were carried out:

1. B.P.	....	....	....	100/60.
2. Blood	....Hb	....	....	70%
	R.B.C.			
	W.B.C.			

3 millions/c.mm.  
6,500/c.mm.

3. X-Ray after Ba. Meal:— Extra gastric tumour displacing the stomach towards the right side.

She was operated upon on 20-6-1949 under spinal anesthesia by Dr. C. P. V. Menon. The abdomen was opened by a left paramedian incision. There was a large cyst of the spleen involving its antero-medial surface. Two pints of dark brown fluid were aspirated. The fluid had a shining appearance over the surface, showing the presence of cholesterol crystals. The cyst was adherent to the under surfaces of the liver and diaphragm. The adhesions were carefully separated and splenectomy was done. Complete haemostasis of the liver bed was effected with gelfoam. The abdomen was closed in layers.

She made an uneventful recovery and was discharged cured on 17-7-1949.

Blood platelet counts on different dates after operation are given below:—

22-6-1949.	....	....	....	1,032,000/c.mm.
24-6-1949.	....	....	....	994,000/c.mm.

25-6-1949.	....	....	....	1,000,000/c.mm.
9-7-1949.	....	....	....	2,600,000/c.mm.

### Remarks

A subcapsular haemorrhage had evidently resulted in the formation of the cyst on the antero medial surface (Fig. 1). The cyst was formed by fibrous tissue and splenic pulp (Fig. 2.) and in places the cyst wall showed organising blood clot (Fig 3). This patient was a young adolescent female, and it is interesting to note that in the reported cases, the majority of the patients were young adult females.

I wish to express my gratitude to the Superintendent, General Hospital, Madras, for permission to publish this case and to the Professor of Pathology for his valuable help in the preparation of this article.

## REVIEWS OF BOOKS

**AUTOBIOGRAPHY OF DR. ROBERT MEYER** (1864-1947). (A short, abstract of a long life). Pp. 126—M/s. Henry Schuman, Inc., 20, East 70th St., New York.

Dr. R. Meyer had a happy childhood in a family richly endowed with tradition and genuine culture. Very early he developed a love for classics, for art and music and a profound appreciation of Nature; these grew through the years, adding greatly to his enjoyment.

Judging from the vast amount of outstanding scientific literary contributions that he has made to embryology and gynaecological and obstetrical pathology, Dr. Meyer's capacity for work must have been prodigious. In this book, he makes frequent references to these papers and at the end of the book there is a complete bibliography by Dr. Emil Novak.

The greater portion of Dr. Meyer's life was lived in the days of German pre-eminence in Medicine and it is most interesting to read his commentaries on his contemporaries and colleagues—men like Ruge, Veit, von Recklinghausen, Aschoff, Virchow, His, Thiersch, Kussmaul, Bumm and others. Several statements such as "who is right is of no importance; what is right is what matters", "the important factor in our life is how we influence other people to think," "I worked for satisfaction," "I do not know competitors, but only collaborators", "to call men authorities is dangerous, for some believe it of themselves" reveal his remarkable poise and equanimity. His experience as a "horse and buggy doctor" at Dedeleben, his adventures in a balloon in the company of Lt. de la Roi, and his experiences as a conductor of a small (war-time) orchestra are a few of the several anecdotes that spice the pages of this book and that reveal Dr. Meyer's delightful sense of humour.

Anyone who reads this fascinating autobiography is bound to agree with this great man that his was "an exceedingly beautiful life which would be worth living once more."

U. M. R.

**Advances in Surgery. Vol. I—1949.** Pp. 554. Illustrations 50. M/s. Interscience Publishers, Inc. New York 3, N.Y.

This book contains seven well written articles on the following subjects: Traumatic shock, stricture of the common bile duct, regeneration of nerves, use of antibiotics in surgery, immersion foot syndrome, blood vessel anastomosis by vitalium tube and bone tumours. The printing is clear and the book is easily readable. The recent developments have been brought out by clear and well arranged discussions. The contributors are men with great experience in the particular subjects on which they have written. Particularly interesting are the chapters on stricture of the common bile duct, blood vessel anastomosis and bone tumours. The book contains a full bibliography on each subject. It should be in every surgeon's library.

D. S. I.

**A Companion in Surgical Studies:** By Ian Aird. 1949. Pp. 1008. E. & S. Livingstone Ltd. Published by M/s.

This is an ideal book for post-graduate study. The author presumes the reader to have a sound knowledge of anatomy, physiology and pathology. The recent advances in surgery are all reviewed up to date in respective sections with apt references at the bottom of the page. The clear marshalling and lucid exposition of facts, the choice diction and fluent language, the bold print and fine get-up all add to its attractiveness. As the author himself remarks, the book is only a "Companion in Surgery" and not a text book for the undergraduate who wants details of common surgical conditions like hernia, hydrocele, piles, etc.

A. N. S.

**Clinical Radiation Therapy.** By Ira I. Kaplan, M.D., F.A.C.R., Clinical Professor of Radiology, New York University Medical College; attending Radiation Therapist, Beth-David Hospital, New York; Director, Radiation Therapy Department, Bellevue Hospital, New York. Second Edition. A volume of 844 pages, with 614 illustrations. Published by Paul B. Hoeber, Inc., New York, 1949. Price \$15.00.

"Clinical Radiation Therapy," a revision of a work originally published in 1937, is a text of



convenient size which will serve admirably as a source of ready reference for superficial and deep therapy technics and for the use of radium and radon. Supervoltage technics are omitted. Kaplan is a strong advocate of radium, which should please those who deplore the decline in its general use.

Indicating dosage in terms of air-dose is followed for the most part. Technical details are complete in each instance. Valuable instructions in general managements of the patient are added.

A brief historical introduction, a concise section on physics with adequate coverage of isotopes, and then a section on general principles, are followed by chapters on specific applications, each with headings and sub-headings facilitating rapid reference. The first of these chapters deals with skin conditions. Diseases of the ear, nose and throat are covered at length, and eye diseases are discussed separately. The treatment of chest conditions is fully described, including bronchiectasis, pertussis, and unex-

plained chronic cough in children. A chapter is devoted to inflammatory and rheumatic disorders. The chapter on the breast is lengthy, taking up the controversial issues. Rectal carcinoma is emphasized under gastro-intestinal diseases. Treatment in gynaecologic disorders is well handled, with great attention to detail in radium procedures. Separate chapters are devoted to urologic and neurologic diseases, to bone conditions, to soft-tissue sarcomas, to blood dyscrasias, to lymphoblastomata, and to reticulo-endothelial diseases. The book concludes with two short chapters on complications and injuries, and on relation of trauma to cancer.

In the discussion of individual disorders, pathology, diagnosis, and treatment are separately covered, though the text remains brief. The book is never tedious, often provocative. Illustrations are good, and the indexing excellent. For everyone who uses radiation therapy, either as a speciality or as part of his office practice, this book is an indispensable addition to his armamentarium.

P.R.R.

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### Subjects for discussion at future meetings

#### 12th Meeting :

##### 1. (a) *Bronchiectasis*—

Dr. R. Mahadevan, Madras.

##### (b) *Lung Abscess*—

Dr. S. J. Mehta, Bombay.

##### 2. *Intestinal Obstruction in Children*—

Opener : Dr. A. E. DeSa', Bombay.

Seconder : Dr. R. A. Irani, Bombay.

##### 3. *Sciatic Syndrome*—

Opener : Dr. S. K. Sen, New Delhi.

Seconder : Dr. V. P. Mehta, Bombay.

#### 13th Meeting :

##### 1. *Hydrocephalus*—

Opener : Dr. A. E. DeSa', Bombay.

Seconder : Dr. S. K. Sen, Delhi.

##### 2. *Prolapse of the Rectum*—

Opener : Dr. K. G. Munsif, Bombay.

Seconder : Dr. S. N. Mathur, Lucknow.

##### 3. *Tuberculosis of the Hip Joint*—

Opener : Dr. A. K. Basu, Calcutta.

Seconder : Dr. B. N. Sinha, Lucknow.

## **Contributors—December, 1949**

1. Dr. R. Mahadevan, M.S., F.R.C.S., Surgeon, Govt. Stanley Hospital, Madras.
  2. Dr. K. C. Jacob, M.D., 56, Harrington Road, Chetpat, Madras.
  3. Dr. C. P. V. Menon, M.S., F.R.C.S., Hony. Surgeon, General Hospital, Madras, & Dr. (Miss) V. C. Anguli, B.Sc., M.B.B.S., Venereal Dept., Govt. General Hospital, Madras.
  4. Dr. S. C. Gupta, M.B., F.R.C.S., Lake Medical College & Hospital, Calcutta.
  5. Dr. L. R. Pathak, M.S., Visiting Surgeon, Arya Medical College Hospital, Ludhiana.
  6. Major K. N. Rao, M.D., D.G.O., District Medical Officer, Bellary.
  7. Dr. Murarimohan Mukherji, M.B., Resident Surgeon, Medical College Hospital, Calcutta.
  8. Dr. B. N. Balakrishna Rao, M.B.B.S., F.R.C.S., F.I.C.S., Professor of Surgery, G. R. Medical College, Gwalior (C.A.)
  9. Lt.-Col. A. N. Subbaraman, M.B.B.S., Asst. Surgeon, Govt. General Hospital, Madras.
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## **NOTICES**

### **6th INTERNATIONAL CONGRESS OF RADIOLOGY, LONDON**

The 6th International Congress of Radiology will be held in London from 23rd - 29th July 1950. The Headquarters will be the Central Hall, Westminster, and meetings will also take place at the Church House and Caxton Hall. In addition there will be a Scientific Exhibition at the Central Hall, and a Technical Exhibition of apparatus in the Halls of the Royal Horticultural Society.

Those wishing to attend the Congress as Full Members (£. 7-7-0), or as Junior Members (under 30 years of age on January 1st 1950 - £. 4-4-0) must be members of a radiological society or sponsored by a radiological society.

Application should be made by form. Forms and information may be obtained from:—

The Secretary,  
6th International Congress of Radiology,  
45, Lincoln's Inn Fields,  
London, W.C. 2.

From this address you should be able to obtain details regarding travel arrangements, demonstrations to take place in the radiological departments of London Hospitals, the submission of papers and exhibits, and the programme of tours to centres of interest in Great Britain.

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**ASSOCIATION OF PHYSICIANS OF INDIA**

The Annual Conference of the Association of Physicians of India will be held at Lucknow on the 15th, 16th and 17th March 1950. There will be a symposia on:—

- (1) Anklystomiasis
- (2) Peptic Ulcer
- (3) Treatment of Malaria.

For further information, please communicate with Dr. S. S. Misra, 12, Clyde Road, Lucknow.

---

**INTERNATIONAL ANATOMICAL CONGRESS, OXFORD**

The International Anatomical Congress will take place at Oxford from 25th - 28th July 1950. Application for membership should be made by form. Application forms, and information regarding travel arrangements, programme, and accommodation can be obtained from:—

The Congress Organiser,  
International Anatomical Congress, 1950,  
Department of Human Anatomy,  
University Museum,  
Oxford.

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